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VOL. CXLIV.—No. 3731] LONDON: FRIDAY EVENING, JULY 15, 1927 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Government of the PUNJAB REQUIRE the SERVICES of an ASSISTANT SUPERINTENDENT for the CENTRAL WORKSHOPS at AMRITSAR.

Candidates should hold a recognised degree or diploma in mechanical engineering or equivalent qualification. They should have administrative experience and be competent to assist in the calculations and design of machinery for large irrigation schemes. Age about 27-32 years; single man preferred.

Five years' agreement in first instance. Pay in accordance with an age scale, e.g., age 27, Rs. 525 a month plus overseas pay £15 a month; age 32, Rs. 725 a month plus overseas pay £25 a month. Provident Fund, with Government bonus of 100 per cent. of subscription. Free first-class passage to India and return passage on satisfactory termination of agreement. (Overseas pay and return passage admissible only to an officer of non-Asiatic domicile.) Strict medical examination.

Forms of application and further particulars may be obtained (upon request by postcard) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 30th July, 1927. 5955

Wanted at Once, Tempo- RARY DRAUGHTSMEN, quick, accurate, with general knowledge of Civil Engineering and Building Construction. Preference given to ex-Service men.—Apply, giving full particulars of experience, age, salary required, when disengaged, and enclosing copies of recent testimonials, to CIVIL ENGINEER-IN-CHIEF, Admiralty, S.W. 1. 5947

The University of Sheffield.
SESSION 1927-28.
Vice-Chancellor: SIR HENRY HADOW, C.B.E., D.Mus., LL.D.

DEPARTMENTS OF MECHANICAL, ELECTRICAL, AND CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY, AND GLASS TECHNOLOGY.

The Courses in the above Departments extend over three or four years and prepare students to become specialists in one or other of these branches of Applied Science.

The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation and research.

Part time Courses are arranged for students who desire to take special portions of any of the regular Courses.

In Mining Engineering and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students who come to the University from works or collieries to take six months' Courses of study at the University and six months' practice at the works or colliery each year for a period of four years. During the first year such students should spend three terms at the University.

The LECTURE COURSES commence OCTOBER 5th, 1927.

The TECHNICAL LABORATORY COURSES commence SEPTEMBER 27th, 1927.

For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates awarded on their successful completion, application should be made to

W. M. GIBBONS,
Registrar.
5917

University College of Swansea.
(A Constituent College of the University of Wales.)
APPLIED SCIENCE DEPARTMENTS.
ENGINEERING.

Professor: FREDERIC BACON, M.A. (Cantab.), A.M. Inst. C.E., M.I. Mech. E., M.I.E.E.
Lecturer in Electrical Engineering: R. G. ISAACS, M.Sc. (Bristol), B.Sc. (Lond.), A.M.I.E.E.
Lecturer in Civil Engineering: A. A. FORDHAM, B.Sc. (Lond.), A.M. Inst. C.E., M.I. Struct. E.
Assistant Lecturer: J. SELWYN CASWELL, A.M.I. Mech. E.

METALLURGY.

Professor: C. A. EDWARDS, D.Sc. (Manchester).
Lecturer: L. B. PFEIL, D.Sc. (Lond.), A.R.S.M.
Assistant Lecturers: J. C. ARROWSMITH, M.Met. (Sheffield); J. C. JONES, M.Sc. (Wales).

The College offers a number of exceptional advantages to Students who aim at entering upon professional careers in Engineering or in Metallurgy. It is situated in the heart of an industrial area, which includes a large number of works of very varied character, and presents an unrivalled variety of metallurgical practice. The manufacturers of the district, who contribute largely to the support of the College, give the Staff and Students of the Applied Science Departments every access to the works, and the Managers, Engineers, and Technical Officials co-operate with the Staff of the College in making visits to works of practical educational value to the Students.

Courses of study are provided (1) for the B.Sc. Degree of the University of Wales in (a) Civil Engineering; (b) Mechanical Engineering; (c) Electrical Engineering; (d) Metallurgy; and (2) for Diplomas of the College in (a) Civil Engineering; (b) Mechanical Engineering; (c) Electrical Engineering; (d) Metallurgy.

Persons who are not desirous of studying for Degrees or Diplomas may attend selected College Classes, provided they satisfy the authorities of the College that they are qualified to benefit by such classes.

Entrance Scholarships will be offered for competition in September, 1927.

Particulars concerning admission to the College, and of the Entrance Scholarships, may be obtained from the undersigned.

EDWIN DREW,
Registrar.
Singleton Park, Swansea. 5996

The University of Liverpool.
FACULTY OF ENGINEERING.

The FACULTY of ENGINEERING invites APPLICATIONS from Graduates of the Liverpool University in Engineering for TWO MUNITIONS COMMITTEE RESEARCH FELLOWSHIPS, tenable for two years in the Departments of Mechanical, Electrical, Civil or Marine Engineering or in Naval Architecture or Metallurgy. The value of the Fellowships is £250 for the first year and £350 for the second year.

Applications, with an outline of the research contemplated, should be forwarded to the DEAN OF THE FACULTY before July 23rd. 5943

The Engineer

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PUBLIC NOTICES

Crystal Palace School of Prac- TICAL ENGINEERING.
Founded 1872.
MECHANICAL AND CIVIL ENGINEERING DIVISIONS.
PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.
Assisted by Staff of Lecturers and Instructors
Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years.
Students admitted at beginning of any term. 5881

Northampton Polytechnic INSTITUTE,
ST. JOHN-STREET, LONDON, E.C. 1.
SCHOLARSHIPS IN ENGINEERING AND OPTICS.

An EXAMINATION will be held on JULY 20th and 21st at the Polytechnic for the award of the following Scholarships:—

THREE SCHOLARSHIPS IN ENGINEERING, VALUE £18 PER ANNUM.

These Scholarships are tenable at courses extending over four years in Civil, Mechanical, Electrical, Aeronautical, or Radio Engineering, and including ten months' practical experience in the works of large industrial firms.

ONE SCHOLARSHIP IN OPHTHALMIC OPTICS, VALUE £18 PER ANNUM.

For further information apply to
S. C. LAWS, M.A., M.Sc.,
5919 Principal.

Sudan Government, Education DEPARTMENT.
A LECTURER in MATHEMATICS is REQUIRED for the Gordon College, Khartoum. Candidates should be under 30 years of age, preferably unmarried, and should possess a degree of some recognised University either in science or in arts with some distinction in mathematics. Commencing salary £E480 per annum (£E1 equals £1 0s. 6d.), the appointment to be in the first instance for two years, but thereafter will be permanent and pensionable if the candidate is found suitable. Three months' leave per annum on full salary with assisted passage allowance. Strict medical examination.—Full particulars can be obtained from, and applications should be lodged with, the CONTROLLER, Sudan Government London Office, Wellington House, Buckingham-gate, S.W. 1. Envelopes to be marked "Lecturer." 5953

PUBLIC NOTICES

Bethnal Green Board of GUARDIANS.
INSTALLATION OF BOILERS AND HEATING AND HOT WATER SUPPLY.

The Guardians invite TENDERS for (a) the INSTALLATION of BOILERS (alternative schemes), and (b) the INSTALLATION of HEATING and DOMESTIC HOT WATER SUPPLIES (alternative schemes) at the Bethnal Green Children's Homes, High-road, Leytonstone, E. 11.

The plans and specification of the work may be inspected at the undermentioned address any week-day between the hours of 10 a.m. and 12 noon and 2 p.m. and 4 p.m. (Saturdays excepted), and a set of either specifications with forms of Tender will be supplied upon payment of a deposit of £2, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, in envelopes marked "Tenders for Boilers" or "Heating and Hot Water Supplies," as the case may be, must be delivered at my office not later than Twelve Noon on Tuesday, the 26th July, 1927.

The Guardians do not bind themselves to accept the lowest or any Tender.

By Order,
C. FAULKNER JONES
Clerk to the Guardians.
Administrative Offices,
Bishop's-road, London, E. 2,
23rd June, 1927. 5979

The Mynyddislwyn Urban Dis- TRICT COUNCIL.
NEW BRIDGE.

The above Council invite TENDERS for the SUPPLY and ERECTION of STEEL WORK in connection with the Construction of the New Lattice Girder Bridge, 105ft. span, over the River Sirhowy, near Ynysddu.

Specifications, quantities and copies of the plans may be obtained from Mr. Sydney T. Monte, A.M.I. Struct. E., Acting Surveyor, Council Offices, Pontllanfraith, Mon., upon the deposit of Five Guineas, which will be refunded upon receipt of a bona fide Tender and the return of the drawings.

Sealed Tenders, addressed to the undersigned, must be received not later than Monday, the 25th July, endorsed "Tender for New Bridge."

The Council do not bind themselves to accept the lowest or any Tender.

TREVOR C. GRIFFITHS,
Clerk to the Council.
Blackwood, Mon.,
9th July, 1927. 5956

PUBLIC NOTICES

County Council of the County OF ARGYLL.
NEW TYNDRUM-BALLACHULISH ROAD.
CONTRACT NO. 1.
CARNOCH TO KINGSHOUSE SECTION, 12¼ Miles.

CLEARING, FENCING, DRAINAGE, EARTHWORKS, BRIDGES, CULVERTS, RETAINING WALLS, CARRIAGEWAY, AND OTHER WORKS.

The Council are prepared to receive TENDERS from experienced Public Works Contractors of good standing for the CONSTRUCTION of the FIRST SECTION of the NEW TYNDRUM-BALLACHULISH ROAD, from Carnoch, through Glencoe, to the vicinity of Kingshouse. The work upon this section involves a considerable amount of excavation in rock and for water courses, together with the construction of Reinforced Concrete Bridges, Culverts, &c.

Drawings and specifications may be seen on and after 18th July, 1927, at the offices of the Chief Engineer, Ballachulish East, Argyll; the Ministry of Transport, 122, George-street, Edinburgh; the Ministry of Transport (Roads Department), 7, White hall-gardens, London, S.W. 1.

Specification, bill of quantities, form of Tender, and full information may be obtained on and after the same date at the office of the Chief Engineer, Mr. James M'Gregor, D.S.O., M. Inst. C.E., Ballachulish East, Argyll, on depositing £3 3s., which deposit will only be returned on receipt of a bona fide Tender and the return of all the documents. Cheques should be made payable to the County Council of Argyll.

A conveyance will be provided, and an engineer will meet contractors at Ballachulish Railway Station, at 1.35 p.m. on 22nd July, 1927, to show them over the route.

Sealed Tenders, endorsed "Tender, New Tyndrum-Ballachulish Road, Contract No. 1," must be lodged with the undersigned not later than 8th August, 1927.

The Council do not bind themselves to accept the lowest or any Tender, and in view of the special character of the work, regard will be had to the standing and experience of the several contractors tendering.

M. SINCLAIR,
County Clerk.
County Offices,
Lochgilphead, Argyll,
13th July, 1927. 5963

TO ENGINEERING FIRMS, TIMBER MERCHANTS.

Tenders are Invited by the Corporation of Dartmouth for the SALE or OCCUPATION of certain VACANT and COMMODIOUS PREMISES situate at Dartmouth, adjoining the River Dart. The premises are in first-class condition, are stone built and roofed with corrugated iron. There is a floor area of approximately 9221 square feet, which is almost clear space and is under cover of the roof. In addition there is a yard area of 905 square feet. The buildings are admirably suited for engineering or foundry works purposes or would make an ideal works for the carrying on of an industry for the manufacture of joinery or as a depot for storing timber. There is on the premises a Tangye Steam Engine in full working order, and also a No. 1 Cornish Boiler certified to be in order for working at 80 lb. pressure.

A good and plentiful supply of water is available from an artesian well 72ft. deep, situate within the building.

The premises may be inspected by appointment made with the undersigned, from whom full particulars may also be obtained.

The Corporation owns the foreshore abutting the premises and the persons to whom the property is sold or let may be able to make satisfactory arrangements with the Corporation as to the use of the river frontage.

Electric power is available in the district, as also is gas.

Sealed Tenders or Offers for the premises, endorsed "Dartmouth Paint Works," should be sent or delivered to the undersigned not later than the 30th day of July.

The Corporation does not bind itself to accept the highest or any Tender.

GILBERT JONES,
Town Clerk.
Guildhall, Dartmouth. 6009

The Guardians of the Poor of the Parish of Lambeth hereby invite TENDERS for the PROVISION and INSTALLATION of a MULTITUBULAR HEATER at their Lambeth Hospital.

Specification, together with form of Tender, may be obtained from this office. Tenders are returnable on or before Tuesday, 19th instant. The Guardians do not pledge themselves to accept the lowest or any Tender.

By Order,
JAMES L. GOLDSPINK,
Clerk to the Guardians.
Guardians' Offices,
128, Brook-street, Kennington, S.E. 11,
6th July, 1927. 5962

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PUBLIC NOTICES

Rural District Council of CHELMSFORD.

WRITTLE SEWERAGE.—CONTRACT NO. 2.

The above-named Council invite TENDERS for MAKING, DELIVERING, ERECTING, SETTING TO WORK, and MAINTAINING for a specified period at their Sewage Outfall Works at Writtle, Essex :—

TWO OIL ENGINES and TWO SEWAGE TYPE CENTRIFUGAL PUMPS, each of 250 gallons per minute capacity, and other Work incidental thereto.

Copies of the plans, general conditions and specification may be obtained on application to the undersigned upon payment of £1, which will be returned on receipt of a bona fide Tender and the return of the documents loaned.

Sealed Tenders, endorsed "Writtle Sewage, Contract No. 2," to be delivered to the Clerk to the Council, A. S. Duffield, Esq., 96, High-street, Chelmsford, on or before Monday, the 8th day of August, 1927.

The Council do not bind themselves to accept the lowest or any Tender.

By Order,
JAMES DEWHIRST,
Engineer.

Council Offices,
Waterloo-lane, Chelmsford,
13th July, 1927. 6011

State Electricity Commission

OF VICTORIA, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Works, Victoria, Australia, of ONE (1) ELECTRICALLY OPERATED DEEP DREDGER for BROWN COAL, in accordance with Specification No. 27/70.

Copies of Tender form, specification and drawings, &c., will be available upon application to :—

The Agent-General for Victoria,
Victoria House, The Strand,
London, England ; and
Herr J. Kitzing,
Bergwerksdirektor,
Grube Marga, Bei Senftenberg,
Germany.

PRELIMINARY DEPOSIT.—A preliminary deposit of £50 is to be lodged with Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered at the office of the Agent-General not later than 29th August, 1927.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
Acting Secretary.

5935

State Electricity Commission

OF VICTORIA, AUSTRALIA.
22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Scheme, Victoria, Australia, of TWO 10,000 K.W. BACK-PRESSURE TURBO-GENERATORS and ACCESSORY PLANT in accordance with Specification No. 27/56.

Copies of Tender form, specification, &c., will be available upon application to :—

The Agent-General for Victoria,
Victoria House, The Strand,
London, England.

Charge £5 5s. for four copies of Tender form, conditions of contract and specification complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies £1 11s. 6d. each, not returnable.

A preliminary deposit of £100 is to be lodged with Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered as directed in Clause 3 of General Conditions of Tendering not later than 14th November, 1927.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
Acting Secretary.

5847

State Electricity Commission

OF VICTORIA, AUSTRALIA.
22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Scheme, Victoria, Australia, of FIVE CENTRIFUGAL FEED PUMPS, in accordance with Specification No. 27/57.

Copies of Tender form, specification, &c., will be available upon application to :—

The Agent-General for Victoria,
Victoria House, The Strand,
London, England.

Charge £5 5s. for four copies of Tender form, conditions of contract, specification, and drawings complete.

This charge will be returned in the event of a bona fide Tender being received. Extra copies £1 11s. 6d. each, not returnable.

A preliminary deposit of £100 is to be lodged with Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered as directed in Clause 3 of General Conditions of Tendering not later than 21st November, 1927.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
Acting Secretary.

5940

State Electricity Commission

OF VICTORIA, AUSTRALIA.
22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Scheme, Victoria, Australia, of ONE 40-TON ELECTRICALLY OPERATED TRAVELLING CRANE, in accordance with Specification No. 27/58.

Copies of Tender form, specification, &c., will be available upon application to :—

The Agent-General for Victoria,
Victoria House, The Strand,
London, England.

Charge £5 5s. for four copies of Tender form, conditions of contract, specification, and drawings complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies £1 11s. 6d. each, not returnable.

A preliminary deposit of £100 is to be lodged with Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered as directed in Clause 3 of General Conditions of Tendering, not later than 14th November, 1927.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
Acting Secretary.

5976

State Electricity Commission

OF VICTORIA, AUSTRALIA.
22-32, WILLIAM-STREET, MELBOURNE, AUSTRALIA.

TENDERS are hereby INVITED for the MANUFACTURE, SUPPLY and DELIVERY for the Yallourn Brown Coal Scheme, Victoria, Australia, of FOUR H.P. WATER-TUBE BOILERS and ACCESSORY PLANT and STEELWORK for BUILDINGS, &c., in accordance with Specification No. 27/55.

Copies of Tender form, specification, &c., will be available upon application to :—

The Agent-General for Victoria,
Victoria House, The Strand,
London, England.

Charge £5 5s. for four copies of Tender form, conditions of contract, specification and drawings complete. This charge will be returned in the event of a bona fide Tender being received. Extra copies, £1 11s. 6d. each, not returnable.

A preliminary deposit of £100 is to be lodged with Tender.

Tenders on prescribed form, properly endorsed and addressed, must be delivered as directed in Clause 3 of General Conditions of Tendering, not later than 28th November, 1927.

The Commission does not bind itself to accept the lowest or any Tender.

W. J. PRICE,
Acting Secretary

5965

PUBLIC NOTICES

South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of :—

1. OVERHEAD TRAVELLING CRANES (Hand Power).
2. POINTS and CROSSINGS, &c.
3. STEEL RAILS and FISH-PLATES (20,500 Tons approx).
4. DOG SPIKES, FISH BOLTS, NUTS and WASHERS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Co., Ltd., marked "Overhead Travelling Cranes (Hand Power)," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 29th July, 1927.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 5s. for each copy of Specification No. 1, and of £1 for each copy of Specifications Nos. 2 to 4.

Copies of the drawings may be obtained at the offices of Messrs. Robert White and Partners, the Company's Consulting Engineers, 2, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, S.W. 1,
13th July, 1927. 6015

West Riding County Council.

ROBEY TRACTOR.

The County Council of the West Riding of Yorkshire are prepared to receive TENDERS for the PURCHASE of ONE 5-TON STEAM TRACTOR, Overtype, by Robey, built 1918, mounted on steel wheels and fitted with differential gear and winding drum. Insured for 200 lb. per square inch working pressure. In good running order. The tractor for disposal may be inspected at the County Council's Central Depot, Thornes, Wakefield.

Sealed Tenders, endorsed "Tender for Robey Tractor," to be delivered at the office of the CLERK OF THE COUNTY COUNCIL, County Hall, Wakefield, not later than Saturday, the 30th day of July, 1927.

Office of the Clerk of the County Council,
County Hall,
Wakefield.
July, 1927. 5967

Coimisiun Um Stat-Sheirbhis.

POST VACANT.

HYDRO-ELECTRIC DEVELOPMENT ON THE RIVER SHANNON.

APPLICATIONS are INVITED from competent Engineers for a POST as ELECTRICAL MACHINERY ENGINEER, to be filled about next October on the Electrical and Mechanical Staff of the above-mentioned constructional works. Salary £400 per annum, with possible increases to £500 per annum, inclusive.

The appointment, which will be temporary and non-pensionable, will be made by the Minister for Industry and Commerce on the recommendation of the Civil Service Commissioners.

The latest date for receiving applications, which must be on the prescribed form, is 30th July, 1927. Copies of the form and further particulars may be obtained from the SECRETARY, Civil Service Commission, 33, St. Stephen's Green, Dublin.

W.H.Co.
8/8536.

Municipal Corporation of RANGOON, BURMA.

APPOINTMENT OF EXECUTIVE ENGINEER, WATER AND SEWERAGE DEPARTMENT.

APPLICATIONS are INVITED for the POST of EXECUTIVE ENGINEER, WATER and SEWERAGE, to be under the Chief Engineer of the Corporation of Rangoon.

AGE.—Preferably between 35 and 40.

QUALIFICATIONS.—Candidates must be a Member or Associate Member of the Institution of Civil Engineers or hold some equivalent qualification.

EXPERIENCE.—Candidates should have previous municipal experience, especially in the inception and execution of large water supply and sewage disposal systems.

SALARY.—Rs. 1200 for the first year, rising by annual increments of Rs. 100 to Rs. 1700 per month, plus an overseas allowance of Rs. 150 per month and a motor car allowance of Rs. 150 per month. The officer appointed will be required to subscribe to the Municipal Provident Fund. Subscriptions are payable at the rate of 8 1-3 per cent. of salary and an equal amount is contributed by the Municipal Corporation. No exchange compensation will be allowed.

The appointment will be permanent, subject to a probationary period of one year. A free first-class passage to Rangoon will be provided and leave and leave allowances will be in accordance with the Fundamental rules applicable to officers in superior service under the Government of India.

Further particulars may be obtained from the undersigned, by whom applications will be received up to the 31st July, 1927.

OGILVY GILLANDERS AND CO.,
Reference R 2650,
67, Cornhill, London, E.C. 3.

5938

Walton-upon-Thames Urban DISTRICT COUNCIL.

ENGINEER AND MANAGER, ELECTRICITY UNDERTAKING.

APPLICATIONS are INVITED for the above APPOINTMENT.

The undertaking is being acquired and taken over from a Company which now operates the same, and is a distributing undertaking, current being purchased in bulk.

The successful applicant will be required to take up his duties as soon as possible and will be responsible to the Council for the taking over, management, and development of the whole of the undertaking, including accounts.

The salary is at the rate of £500 per annum.

Applications, stating age, qualifications and experience, and accompanied by copies of three recent testimonials, must be forwarded in an envelope, marked "Electrical Manager," to reach the undersigned not later than the first post on Wednesday, the 27th July, 1927.

THOS. K. DOBSON,
Clerk of the Council.

Council Offices,
Walton-on-Thames,
12th July, 1927. 5983

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

MERZ and McLELLAN ACKNOWLEDGE with thanks the APPLICATIONS received for the vacant POSITION advertised on 10th June, which has now been FILLED. 5988 A

WANTED, an ASSISTANT MECHANICAL ENGINEER for a large Steel Works Plant. Applicant must have had experience in Bessemer and Siemens Plants and Rolling Mills.—Address, giving particulars of experience, age, salary required and when at liberty, 5964, The Engineer Office. 5964 A

WANTED, ASSISTANT SUPERINTENDENT for large Works engaged on light mass production. Successful executive experience as well as a good practical knowledge of Tools and Methods necessary.—Address reply to "EXECUTIVE," Wm. Porteous and Co., Advertising Agents, Glasgow. P3412 A

APPLICATIONS are INVITED for the POSITION of MANAGER in a Marine Engine Works. Candidates must have good theoretical and practical knowledge and experience, including sea service, in connection with Reciprocating and Turbine Steam Engines, Diesel Engines, Boilers, and Foundry Work.—Address, giving full particulars, age, qualifications, experience, and salary required, 5985, The Engineer Office. 5985 A

AUTOMOBILE WORKS REQUIRE CHEMIST with knowledge of Metallurgy, Heat Treatment, and able to Analyse Lubricants, &c.—Address, stating qualifications, age, salary required, sending copies of references only, 5958, The Engineer Office. 5958 A

SITUATIONS OPEN (continued)

ENGINEER REQUIRED for Designing and Experimental Branch of a Manufacturing Firm. Must have good working knowledge of the theory and practical application of Refrigeration and be generally proficient in engineering problems associated with Small Freezing Plant. Preference will be given to young engineer graduate of good address and proved ability and who has had a few years' practical and varied experience.—Address in first instance, giving full particulars, 5999, The Engineer Office. 5999 A

ENGINEER REQUIRED, with Extended knowledge of design and construction of modern Kneading and Mastication Machinery in large sizes. Good salary and prospects for really first-class man.—Address in confidence, stating full details of technical experience, age, salary required, 6000, The Engineer Office. 6000 A

ENGINEER-SALESMAN REQUIRED by Well-known house to Sell Engineers' Stores in London. Similar vacancy in Glasgow.—Applications, giving age, technical and commercial experience and salary expected, to be addressed to P3426, The Engineer, Office. P3426 A

GENERAL WORKS MANAGER, to Take Charge of Old-established Business producing Pig Iron, Finished Iron and Steel. Must possess sound technical knowledge and experience and have real commercial ability. Excellent prospects for right type of man.—Address in strictest confidence, 6006, The Engineer Office. 6006 A

PRODUCTION MACHINE SHOP ENGINEER WANTED by an important Rolling Mill and Engineering Concern, fully conversant with up-to-date Machine Shop Practice, in particular Precision Screwing Machines. Candidates must have a sound theoretical and practical training, strict disciplinarian, and able to control a large number of men.—Address age, salary, references, 5957, The Engineer Office. 5957 A

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WORKS MANAGER of Sound Metallurgical Training, to Take Complete Charge of the Low Moor Works of Messrs. Robert Heath and Low Moor, Limited. Good prospects for energetic man. Candidates should not be more than 45 years of age.—Replies, which will be treated as strictly confidential, should be addressed to the CHAIRMAN, Robert Heath and Low Moor, Limited, 90, Cannon-street, London, E.C. 4. 6005 A

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REQUIRED, First-class AERONAUTICAL DRAUGHTSMEN, with full knowledge of the requirement of Aircraft Design. Only men of sound experience need apply. State full expreience and salary required.—Address, 5889, The Engineer Office. 5889 A

REQUIRED IMMEDIATELY for a Period of from 6 to 12 months, a capable DRAUGHTSMAN DESIGNER for Steel-frame Buildings. Salary £8 per week.—Apply personally between 10 a.m. and 4 p.m., with references, to CHIEF CIVIL ENGINEER, Metropolitan Rly., Baker-street, 5981 A

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SITUATIONS WANTED

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AN Experienced TECHNICAL SALESMAN, A.M.I.E.E., widower (46), fluent French, German, Spanish, Dutch, &c., OFFERS Temporary or Permanent SERVICES as SALES ORGANISER, European Continent, instruct travellers, or similar capacity, any line. Free at once.—Address, P3416, The Engineer Office. P3416 B

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ENGINEER SEEKS POSITION of RESPONSIBILITY. Wide experience at home and abroad with general, railway, constructional, manuf., administrative organisation and productive efficiency of approved ability.—Address, P3350, The Engineer Office. P3350 B

ENGINEER, Sound Technical Qualifications, Extensive business experience and special organising abilities, late manager leading British firm in India, DESIRES responsible APPOINTMENT, home or abroad.—Address, P3389, The Engineer Office. P3389 B

ENGINEER, with Valuable Connection in Marine and Stationary Diesel Engines, is OPEN to REPRESENT a good FIRM for Scotland.—Address, P3410, The Engineer Office. P3410 B

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M.I.M.E., A.M.I.C.E., Conversant from Experience with all matters relating to design, manufacture, sales and finance as applied to general engineering, particularly products for engineers, public works contractors, municipal authorities, and large industrial organisations, OFFERS his SERVICES in a MANAGERIAL or ADMINISTRATIVE CAPACITY.
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M.I.A.E., A.M.I. Mech. E., 14 Years' Administrative control, production engineer, works manager, &c.; sound commercial experience, modern methods, and jig and tool expert, DESIRES PROGRESSIVE POSITION, or would Represent Engineering Firm of repute. Age 39 years.—Address, P3404, The Engineer Office. P3404 B

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DRAUGHTSMAN-DESIGNER, University Educ., long experience drawing-office and also practical in responsible positions, oil engines, compressors, pumps, general engineering, research work and patents, progressive, inventive, energetic excellent refs., SEEKS ENGAGEMENT as a DRAUGHTSMAN or ASSISTANT ENGINEER. Speaks French and German. Accept modest salary. London district.—Address, P3422, The Engineer Office. P3422 B

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For continuation of Small Advertisements see page 3.

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See Illustrated Advt. in issue of July 8th.

A Seven-Day Journal

The Institution of Electrical Engineers' Conversazione.

THE outstanding feature of the Institution of Electrical Engineers' conversazione, which was held at the Natural History Museum, South Kensington, on Thursday, July 7th, was a series of dramatic scenes or pictures with appropriate stage and lighting effects, and with 120 volunteer artists in character costume. The spectacle was entitled "Light Down the Ages," and was illustrative of the advance and taming of electricity. The Electric Lamp Manufacturers' Association provided the performers from their staffs, and also the general equipment, whilst Major W. R. Creighton devised the spectacle, in collaboration with Dr. W. H. Eccles, the President of the Institution, Mr. W. E. Bush, and Mr. A. J. Makower. The first part of the spectacle was composed of five pictures, starting with the early days of man, and ending with the Victorian days; whilst the second part was composed of four pictures covering the introduction of the arc lamp, the carbon filament lamp, the metal filament and the gas-filled lamp. In a striking scene, depicting the Crystal Palace Exhibition of 1882, the carbon filament lamp was seen lighting a magnificent chandelier; whilst the next picture showed the Parsons turbine and the metal filament lamp of 1906. The last picture was a scene of riotous movement and colouring, demonstrating the complete control of electricity for man's enjoyment. During the course of the evening, the President presented Dr. Elihu Thomson, honorary member, with the Faraday Medal of the Institution, which was awarded to him by the Council this year.

Mining Subsidence.

THE final report of the Royal Commission on Mining Subsidence was issued on Friday, July 8th. The Commissioners state that while some surface subsidence as a result of coal mining is inevitable, its extent cannot be accurately predicted, even when all the conditions are fairly well ascertained. While subsidence is inevitable, damage, it is held, is by no means a necessary consequence of it. By the adoption of precautions which normally are not of prohibitive cost, the effect of subsidence upon surface buildings can now be minimised. Some of the existing damage might have been avoided if greater foresight in construction had been exercised. The damage caused by subsidence to houses and buildings, sewers, water, gas and electricity mains, tramway lines and so on, is in the aggregate much less than the Commissioners had expected. Discussing remedies for it, they say that hydraulic stowage in this country is in general impracticable. Much is hoped for from the systematic examination by the British Colliery Owners' Research Association into the effect upon the surface of different methods of mining. Closer attention to the scientific lay-out of the surface is, they say, demanded, while by special methods of building construction much can be done to minimise the risk of surface damage. The Commissioners recommend the introduction of legislation to provide for the compulsory disclosure of colliery underground plans to prospective builders, local authorities and owners of houses desiring to prefer claims for compensation.

An Aircraft Manufacturer's Complaint.

WE have always understood that the post-war air policy of this country was centred upon the maintenance not of a large air force, but of a force organised for extensive and rapid expansion in times of emergency. To give effect to that policy, it is essential that behind the Air Force itself there should be an aeronautical industry which simultaneously can be similarly expanded. Judging from the number of firms actively engaged to-day in the aeronautical industry, the Air Ministry's policy may be accounted successful. It is no poor achievement to have ensured in these bad times the continued existence of four or five first-class firms devoting at least part of their activities to the production of aero-engines and of something like eighteen independent concerns wholly or partly devoted to the construction of aircraft. It has no doubt been difficult to ensure to these firms an adequate supply of orders to keep their works going. With the relatively small number of machines required each year, it would be strange, indeed, if in their struggles to keep going aircraft manufacturers did not at times feel that the Government might do more than it does to help them. Sir Ernest Petter, we notice, had something to say on this subject at the annual meeting of his company held at Yeovil on Tuesday of this week. He had to report that at the moment there was a marked paucity of orders in the aircraft section of the Westland Works. Emphasising the need for continuity of work in the department, he remarked that when orders ceased to be received for a space of three or four months, it became very difficult to keep the costly aircraft-producing organisation together efficiently. Not only were heavy losses incurred during the period of idleness, but the cost of carrying out contracts when they were received was far higher than it would have been had the works been in continuous employment. Other aircraft manufacturers have from time to time made the same complaint, but it is not easy to see how it can be remedied without a considerable increase in the number of aeroplanes ordered by the Air Ministry in the course of a year.

The British Electrical Industry.

ACCORDING to an official statement received from the economic and statistical department of the British Electrical and Allied Manufacturers' Association, Great Britain is now easily the leading export country in the world for electrical goods. During the past five months of this year British electrical exports were valued at £7,757,000, representing an increase of 11·5 per cent. over the figure for the corresponding period of 1926. During the same period the Swiss exports of electrical goods increased by 10 per cent., American exports were stationary, those from Germany fell by 3 per cent., and those from France declined by 24 per cent. Britain's share of the export trade conducted by the five countries is now 32 per cent., as compared with 23 per cent. in 1913. Over 60 per cent. of all the contracts for generating plant in the world outside the main industrial countries, and over 70 per cent. of all the traction orders, fell, it is estimated, to British manufacturers. During the twelve months ending June, 1927, the orders secured by British firms for generating plant and heavy electrical equipment registered a record in the history of the industry. On a horse-power basis the total increase over 1920 was 28 per cent. On home account there was a decline of 6 per cent., as compared with the 1920 figure, but on export account there was an increase of 134 per cent. In the first six months of this year the orders booked by British firms represented a higher plant capacity than those secured during the whole of 1924 or 1925.

The General Electric Company.

As a general picture, the facts set forth in the preceding paragraph may be taken as representing one side of the position occupied at present by the British electrical industry. But that there is another and less rosy side was made evident by Sir Hugo Hirst at the annual meeting on Tuesday of the General Electric Company. He had to report that the company's earnings had decreased by nearly £50,000. They had not gone ahead during the past year, and were still not going ahead, largely because of the absence of business which they had expected to receive from the coal and steel industries. The company's business in the supply of light apparatus and fittings for use in houses and factories was, Sir Hugo remarked, a very good barometer of the country's state of trade and prosperity. The average value of the company's transactions with the electrical trade had fallen from £6 4s. 11d. in 1920–21 to £3 17s. in 1926–27. Yet the total business was increasing each year. That fact implied an increased number of transactions, which, in turn, meant increased expense in administration, packing, freight and so forth. The past year, he said, was the worst in that respect of the preceding seven, and the current year so far as it had gone showed no marked improvement. In the course of his further remarks, Sir Hugo intimated that the company was now expending well over £100,000 a year on development and research. He also stated that the company had received its first order for an electric passenger locomotive, and had completed with great success the first electric ship-propulsion scheme for the Admiralty. He warmly defended the policy of agreements with competitors for the institution and maintenance of minimum sales prices and strongly urged the establishment of a council of business men charged with the duty of originating a sound and scientific Empire policy for finance, agriculture, trade and industry.

The Fuel Research Board.

THE report for the year 1926 of the Fuel Research Board, issued this week, expresses the opinion that the coal stoppage of 1926 may in the long run prove of advantage to the Board's work, on the ground that the experiences of last year have undoubtedly increased the interest taken by the mining industry in that work, and have led to a greater realisation of its importance. Progress, it is held, will also be facilitated by the right conferred by the Mining Industries Act on officers of the Department to obtain access to underground workings, and to obtain samples of seams opened up or worked. Dealing with the low-temperature carbonisation of coal, the report states that the technical difficulties have now been largely overcome, but that the difficulty remains of devising a method of working that will be sufficiently cheap to make commercially possible the carbonisation of the whole or a large portion of the 40 million tons of coal now burned yearly in the raw state for domestic purposes. In this connection, it is pointed out, it has to be borne in mind that this coal is one of the most highly priced products of our mines. In order to test the position commercially, an arrangement has been entered into with the Gas Light and Coke Company, whereby, with the assistance of the Government, that company will erect and run for a period of three years a low-temperature plant with a throughput of 100 tons per day of the type developed at the Fuel Research Station. A subsidiary company, the Fuel Production Company, Ltd., has been formed in connection with the scheme. The gas company will act as manager for the fuel company, and will bear all management and running costs. At the end of 1930 the gas company will have the option of purchasing the plant. It is hoped that the plant will be at work next winter. Dealing with the Bergius hydrogenation process, the report states that since February, 1927, a continuously working plant with a throughput of about a ton of coal per day has been under investigation. The process, it is remarked, is still far from being developed to a stage at which commercial working is practicable on bituminous coal.

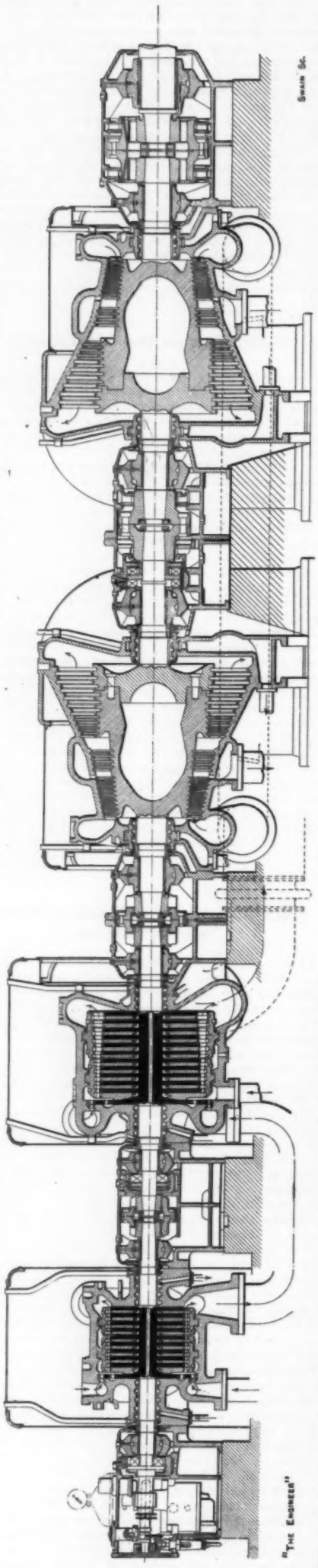
Restrictions on Warship Tonnage.

ALTHOUGH the Three-Power Conference at Geneva has not yet come to an agreement on the broader issues involved, certain decisions have already been taken which, if ratified, will have a marked influence on the future development of certain naval types. At the beginning of the Conference the British delegation proposed that the following limits of tonnage and armament should be adopted for all future craft in the categories concerned:—Flotilla leaders, 1750 tons; destroyers, 1400 tons, with 5in. guns as the maximum calibre in either case; submarines, large type 1600 tons, small type 600 tons, guns not to exceed 5in. Discussion of these proposals has resulted in a compromise being reached, according to which a limit of 1850 tons is established for flotilla leaders and 1500 tons for destroyers, both classes being restricted to 5in. guns. The proposal to divide submarines into two classes was rejected. Instead, a limit of 1800 tons is set for all vessels that may be built in future. The figures of displacement are apparently "standard," which signifies the omission of fuel and reserve feed water. So far as the British Navy is concerned, these limits are above the averages now existing. Our largest flotilla leaders are vessels of 1800 tons, our largest destroyers displace about 1330 tons, and with the single exception of X 1, our submarines do not exceed 1600 tons, the great majority being much below that figure. It seems clear therefore that the new limits have been adjusted with an eye to the interest of foreign naval Powers. Japan and France are both building torpedo craft of very large dimensions, and in France and the United States submarines of 3000 tons are now on the stocks.

From Government to Company Management in Belgium.

THE handing over of the Belgian State Railways to a company under Government control, which took place last year, is likely to be followed by a similar change in the management of the Telegraph and Telephone services. The Minister responsible for the administration of the latter services, Monsieur Anseele, who incidentally is a prominent member of the Socialist Party, submitted last week to the Prime Minister the draft of a Bill designed to bring about some such change in management. The primary object of the proposed measure is said to be the creation for the Telephone and Telegraph Departments of an autonomous financial status, independent of the Government Budgets. The Departments would be invested with borrowing powers to raise the capital necessary for the extension of automatic plant, underground cables, &c., and the security for such loans would evidently have to be the assets of the Departments themselves. The Bill envisages two alternatives, but whether both will be submitted to Parliament will depend on the views of the Prime Minister. According to the first, there would be a Board of Directors, composed of the Minister, seven high officials of the services, and three representatives of the employees. This Board would be assisted by a consultative committee, comprising, besides officials, and employees, a number of members nominated by Parliament and by industrial, commercial, agricultural and co-operative organisations. The other alternative is much milder. Financial autonomy would be given to the Departments, but the management would remain as hitherto. Loans would be arranged through the Ministry of Finance, and the "Régie" would be responsible for providing interest and sinking fund on such moneys. If the policy with regard to the railways is to form a precedent, it is probable that sooner or later the Telegraph and Telephone Departments will be managed very much on company lines, the Government investments in the system being a source of revenue to the State, and the financial interest of private shareholders ensuring, as far as possible, an administration on business lines and free from politics.

16,000 K.W. STORK-ERSTE-BRUNNER TURBO-GENERATOR AT THE MERWEDEKANAAL POWER STATION



The Merwedekanaal Power Station.

No. II. (*Conclusion*).*

HAVING described in our previous article the high-pressure boiler plant at the Merwedekanaal Power Station, we now turn to the turbine to which that plant supplies steam. This machine, constructed by Messrs. Stork Brothers, of Hengelo—who also provided the boiler plant—under license from the Erste-Brunner Maschinenfabrik, is illustrated in the engraving on page 70 as it appeared on the test bed in the makers' works. It is shown in section herewith, while Figs. 4 and 5 illustrate the general arrangement of the plant complete with generator, condensers and auxiliaries as erected at Merwedekanaal. The turbo-generator has a rated capacity of 16,000 kW, at a speed of 3000 revolutions per minute, the alternator having an output of 20,000 kVA at 6000 volts and 50 cycles.

The turbine is designed to work with steam at a pressure of 455 lb. per square inch and a temperature of 752 deg. Fah., and to exhaust into a vacuum of 28·65in. It consists, as will be seen from the illustrations, of a high-pressure, an intermediate-pressure, and two low-pressure cylinders. The high and intermediate-pressure cylinders are of the impulse type, but the reaction principle is employed for the low-pressure cylinders. The steam flows through the latter in parallel and in opposite directions, so that the axial thrusts of the two rotors neutralise each other. Cast steel is used for the casing of the high-pressure cylinder, and a special quality of cast iron for that of the intermediate cylinder, while the low-pressure casings are made of ordinary cast iron. Each turbine rotor runs in its own separate bearings. The rotors of the various cylinders and that of the generator are connected by flexible couplings, except that a rigid coupling is used between the pair of low-pressure rotors.

Since the whole generating unit is about 57ft. 6in. long overall, it is evident that suitable provision for expansion due to temperature changes is necessary. To this end all the bearings have freedom to slide axially except the bearings between the two low-pressure cylinders, which are secured against displacement. These bearings are about midway between the ends of the complete unit. All the turbine rotors are fixed axially in relation to their respective casings by Michell thrust bearings. The double thrust bearing serving the two low-pressure cylinders is designed to be adequate to take the unbalanced load, should the turbine be running with one low-pressure cylinder only in action.

The wheels of both the high-pressure and intermediate-pressure rotors are solid with their respective shafts, the complete rotors, wheels and all being machined from single forgings. The shafts are also bored through from end to end. The practice of turning the wheels from the solid enables them to be closer together than when separate wheels are keyed on the shafts, and thus shortens the length of the turbine and gives greater rigidity to the shafts. It also eliminates in the simplest way possible any risk of wheels becoming loose on account of thermal or centrifugal stresses. The high-pressure cylinder contains ten single impulse wheels, the first having a mean blade diameter of 700 mm., and the other nine all having diameters of 600 mm. In the intermediate-pressure cylinder there are twelve single impulse stages, and here again the first is of a larger diameter than the others. The first stage in this cylinder has a mean blade diameter of 900 mm., all the rest having diameters of 800 mm. Each of the low-pressure rotors carries twenty-three rows of Parsons reaction blading. The mean diameter of the first thirteen rows of blading increases uniformly from 658 mm. to 775 mm. The rotor diameters are then stepped up and the last ten rows of blading have mean diameters rising from 993 mm. to 1200 mm. The blades in the last row of all are 260 mm. long. Defining u as the blade speed in metres per second, we have for the high-pressure cylinder $\Sigma u^3 = 91,880$, for the intermediate cylinder $\Sigma u^3 = 193,760$, and for the low-pressure cylinders $\Sigma u^3 = 465,000$, giving a value of 750,640 in metric units, or 8,080,750 in foot-second units for the complete machine.

At full load, steam is admitted round the full circumference of the first wheel of the high pressure turbine. There are, however, three separate nozzle-boxes round the circumference, steam being only admitted to the second and to the third as the load on the turbine warrants it. Thus, as far as possible, all nozzles in action are working at full efficiency. The main governor, which controls the turbine throttle valve by means of an oil relay, also regulates the admission of steam to the second and third nozzle boxes. The second nozzle box is brought into action when the load on the turbine reaches 8000 kW, and the third when a load of 12,000 kW is attained.

Besides developing 16,000 kW under normal conditions of steam pressure and temperature, the turbine was also specified to develop the same power with steam at 285 lb. per square inch and at a temperature of 707 deg. Fah., and to work under these conditions as economically as a Stork-Erste-Brunner turbine specially designed for them. To meet this requirement Messrs. Stork Brothers arranged for the high-pressure cylinder to be put out of action altogether when the turbine had to run with steam at 285 lb. per square inch only. Live steam is then admitted directly to the intermediate-pressure cylinder and completes its expansion in that and the two low-pressure cylinders. The connection between the high-pressure and the intermediate-pressure cylinder is shut off and the high-pressure cylinder connected directly to the condenser, so that its rotor runs in a vacuum. For running in this manner separate regulating valves designed for the passage of the necessary amount of steam at 285 lb. pressure are provided. The secondary inlet to the intermediate cylinder is shown in the longitudinal section, the steam entering on the down-stream side of the first wheel.

The turbine is provided with two emergency governors mounted on the outboard end of the shaft of the high-pressure rotor. One of them serves to close the main stop valve and the other acts upon the throttle valve, which is normally under the control of the main governor by the action of the oil relay gear. Either of these governors will shut off steam independently of the other if the normal speed of revolution, namely, 3000 revolutions per minute, is exceeded by 10 per cent. The end of the turbine shaft also drives two oil pumps by means of a worm and two worm wheels. These pumps provide the lubricating oil for the bearings and the oil for the relay gear. There is also an auxiliary oil pump driven by a small steam turbine which is used when the main turbine is being started, and which comes into action automatically should the oil pressure at the bearings become too low for any reason.

Partially expanded steam can be bled from the turbine at two points for feed heating. The bleeding

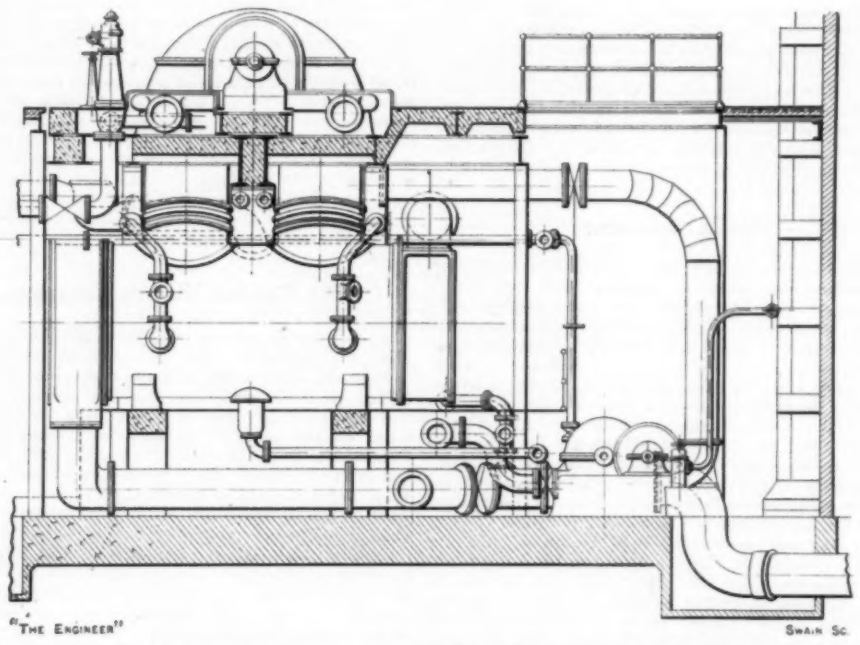


FIG. 4—ARRANGEMENT OF 16,000 KW. TURBO-GENERATING SET—END VIEW

* No. I. appeared July 8th.

MERWEDEKANAAL POWER STATION

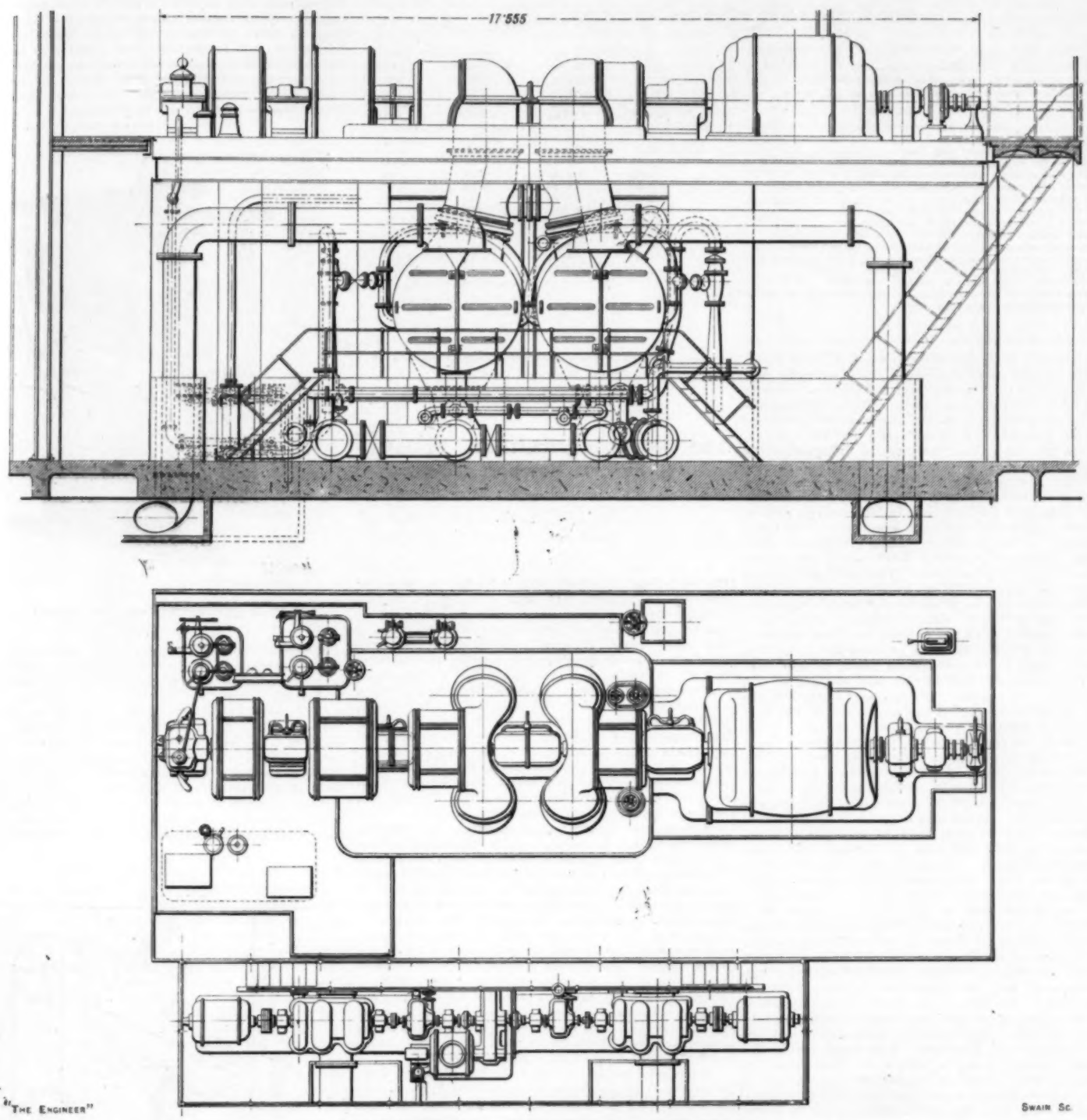


FIG. 5—ARRANGEMENT OF 16,000 K.W. TURBO-GENERATING SET

valves are specially designed to work automatically, being controlled both by the steam pressure in the turbine and by the temperature of the feed water. The steam pressure (and therefore the load on the turbine) decides which of the two valves shall open, whereas the temperature of the feed determines the quantity of steam which shall be bled. When the load is less than 12,000 kilowatts the low-pressure bleeding valve, which draws steam from the casing of the reaction cylinders, is closed, and the second valve higher up along the turbine will be opened. Should the feed water temperature fall below 176 deg. Fah. the amount of opening of whichever bleeding valve is working will be automatically increased, so that a large quantity of steam will be passed to the feed heater from the turbine. The pressure at which steam is bled is about that of the atmosphere.

The turbine is provided with two condensers, one being connected directly to each of the low-pressure cylinders. The condensers are connected together so that the vacuum is necessarily the same in each. Each condenser has a cooling surface of 9418 square feet and is designed to give a vacuum of 96 per cent., or 28·8in. with the barometer at 30in., when supplied with cooling water at 59 deg. Fah. and when condensing 70,000 lb. of steam per hour. The condensers are placed at right angles to the centre line of the turbine, and each receives steam by means of two exhaust branches each of 55·1 in. diameter. This arrangement gives an excellent steam distribution over the cooling surface, as will be gathered from Fig. 5.

The vacuum is maintained by four air ejectors, two for each condenser, which extract the air by means of water jets under pressure. A double set of auxiliaries is provided. Each comprises a circulating pump, air ejector pump, and condensate extraction pump. These two sets are placed in line with each other, as shown in Fig. 5. Each is driven by its own

TABLE I.—*Official Tests of 16,000-kW Stork-Erste-Brunner Turbine.*

Test No.	3	2	1
Approximate load	Full	Three-quarters	Half
Date of tests	8/6/26	7/6/26	7/6/26
Barometer, corrected to 32 deg. Fah., inches	29·85	29·84	29·85
Duration of test, seconds	3,234	4,245	3,771
Steam consumption of turbine, lb. per hour	146,628	111,791	75,504
Average load at terminals (cos $\phi = 1$), kW	16,650	12,945	8,462
Efficiency of alternator (cos $\phi = 1$), per cent.	95·63	95·27	93·96
Power at turbine coupling, kW	17,410	13,580	9,015
Steam consumption at alternator terminals, lb. per kWh	8·803	8·635	8·922
Steam consumption at turbine coupling, lb. per kWh	8·419	8·227	8·375
Absolute steam pressure at stop valve, lb. per sq. in.	466·4	466·4	465·0
Mean steam temperature at stop valve, deg. Fah.	745	768	748
Total heat in steam, B.Th.U. per lb.	1382·9	1395·2	1384·7
Absolute pressure after No. 1 regulating valve, lb. per sq. in.	456·4	456·4	391·0
Absolute pressure after No. 2 regulating valve, lb. per sq. in.	450·8	376·8	204·7
Absolute pressure after No. 3 regulating valve, lb. per sq. in.	443·6	318·5	207·6
Absolute pressure after first wheel of first cylinder, lb. per sq. in.	415·2	321·3	206·2
Absolute pressure between first and second cylinders, lb. per sq. in.	237·5	179·2	120·9
Absolute pressure after first wheel of second cylinder, lb. per sq. in.	199·1	155·0	96·7
Absolute pressure between second and third cylinders, lb. per sq. in.	29·72	22·04	15·31
Absolute pressure after first row of third cylinder, lb. per sq. in.	14·93	10·38	8·25
Average absolute pressure at top of exhaust branches, lb. per sq. in.	0·63	0·51	0·42
Adiabatic heat drop through turbine, B.Th.U. per lb.	468·9	507·4	508·5
Theoretical steam consumption (adiabatic expansion), lb. per kWh	6·982	6·726	6·741
Thermal efficiency of turbine only, per cent.	82·90	81·75	80·15
Thermal efficiency of turbo-generator, per cent.	79·3	77·9	75·2

electric motor, the motors being placed at the ends of the line. Between the two sets is a small auxiliary steam turbine of sufficient power to drive both the sets at once. It is connected to them both by gearing. Under normal circumstances the two pumping sets are driven by their motors and the auxiliary turbine runs with a vacuum in its casing. The turbine is maintained out of action by its own governor as it is driven slightly above its working speed by the motors. Should the current fail, however, or the speed of the motors be reduced for any other cause, the turbine governor admits steam and the turbine takes up the work of driving the pumps automatically without any interruption of the service. On the motors picking up speed again the turbine is again shut down automatically by its governor. Each circulating water pump is designed to deliver 9500 gallons per minute against a total head of 24·6ft. The same pump casing houses the impeller for an air ejector pump, which delivers 2200 gallons of water per minute against a total head of 55·8ft. Each condensate pump has a rated capacity of 13,200 gallons per hour against a total head of 82ft. Each set of these three pumps is driven direct by a three-phase motor of 250 H.P. working on a 380-volt circuit and running at 720 revolutions per minute. The auxiliary turbine for the two groups of auxiliaries has a capacity of 500 H.P. at 4200 revolutions per minute, that speed being reduced to 720 per minute by a reduction gear.

The plant was tested on June 7th and 8th, 1926, by Professor E. Josse, of Charlottenburg University, with the results shown in the accompanying Table I. At the full-load test (16,650 kilowatts at the alternator terminals) the turbine had a steam consumption of 8·803 lb. per kWh with steam at 466·4 lb. absolute pressure and 745 deg. Fah. at the stop valve, and exhausting against an absolute pressure of 0·6329 lb. per square inch. This steam consumption implies a thermal efficiency of 82·9 per cent., reckoned on the power delivered to the alternator shaft, or of 79·3 per cent. on the power delivered at the terminals of the alternator. These figures and the remainder of the figures in Table I. are taken from the report made by Professor Josse and published by him recently in the *Zeitschrift des Vereines Deutscher Ingenieure*. In view of the great interest attaching to the machine we give in Table II. some supplementary figures relating to the tests, kindly supplied by Messrs. Stork Brothers. This second table also includes particulars of a further test made when the machine was about one-quarter loaded. It will be seen that the steam consumption, corrected to specified conditions of load, quality of steam, &c., was better than the guarantees by an average of 1·5 per cent. over full, three-quarter, and half-load range.

Although the turbine was nominally rated as having a full-load capacity of 16,000 kW., the tests showed that it was capable of carrying a load of 17,180 kW without the use of the overload valves. The no-load consumption of the machine at full speed and full excitation was determined as 12,900 lb. of steam per hour under guaranteed conditions of pressure and temperature. During this test both groups of auxiliaries were driven by the auxiliary steam turbine, and the steam consumption of the latter is included in the figure given. The average steam pressure when the test was made was 452·5 lb. per square inch, the temperature of the steam 671 deg. Fah., and the cooling water temperature averaged 66 deg. Fah.

A further test was made with the condensing plant driven by the electric motors, the auxiliary turbine running on vacuum. The quantity of condensate in this case was 9300 lb. per hour. From these two tests it appears that the steam consumption of the auxiliary turbine amounted to 3600 lb. per hour under conditions of guarantee. The guaranteed consumption of this unit was 5510 lb. per hour. When the motors were used to drive the condensing plant the power consumed by each motor was about 145 kW, as against the guaranteed maximum power consumption of 150 kW. It should be mentioned that during all the tests we have mentioned no steam was withdrawn from the turbine for feed water heating, as it would have been difficult to make exact measurements under such conditions.

Messrs. Stork Brothers are to be congratulated on the performance of this interesting turbine, and as makers of the high-pressure boilers as well, they have done their share in making possible the excellent working results obtained at Merwedekanaal—a fine station operated as it deserves to be.

TABLE II.—*Tests of* 16,000-kW *Stork-Erste-Brunner Turbine.*

Test No.	3	2	1	4
Duration of tests, seconds	3,234	4,245	3,771	2,093
Measured quantity of condensate, gallons	13,206	13,206	7,924	2,641
Quantity of condensate per hour at 50 deg. Fah., lb.	147,227	112,146	75,687	45,490
Temperature of condensate, deg. Fah.	87·4	81·1	74·1	77·5
Steam consumption per hour, lb.	146,628	111,791	75,504	45,367
Load on alternator, kW	16,650	12,945	8,462	4,839
Steam pressure (gauge), lb. per sq. in.	452·2	452·2	449·3	449·3
Steam temperature, deg. Fah.	745	768	748	734
Cooling water temperature, deg. Fah	65·7	64·1	63·1	65·8
Corrections for cooling water temperature, per cent.	−2·2	−1·65	−1·34	−2·23
Corrections for steam temperature, per cent.	−0·66	+0·90	−0·33	−1·64
Corrections for steam pressure, per cent.	−0·05	−0·05	−0·10	−0·07
Total corrections, per cent.	−2·91	−0·80	−1·77	−3·94
Corrected quantity of condensate per hour, lb.	142,363	110,898	74,169	43,582
Corrected steam consumption, lb. per kWh	8·54	8·56	8·76	9·02
Nominal loads of machine, kW	16,000	12,000	8,000	4,000
Guaranteed consumption at nominal loads, lb. per kWh	8·44	8·62	8·97	9·85
Corrected consumption adjusted to nominal loads, lb. per kWh	8·51	8·56	8·77	9·24
Correction for variation of load during test, per cent.	0·83	1·30	2·47	—
Corrected steam consumption, final, lb. per kWh	8·44	8·49	8·70	—
Difference between corrected quantity and guarantee, lb. per kWh	0	0·13	0·27	—
Percentage difference, per cent.	0	1·53	2·95	—

The Royal Agricultural Society's Show at Newport, Mon.

No. III.*

WE continue below our account of the machines which were exhibited at the recent Show at Newport of the Royal Agricultural Society.

In the new binder exhibited by Ruston and Hornsby, Ltd., for which a Silver Medal was awarded, lightness of draught has been achieved by a new method of construction of the frame on the one hand, and by the free use of anti-friction roller bearings on the other hand, without sacrificing the necessary rigidity of the whole. For instance, the girder frame is built of steel angles braced by steel gusset plates and riveted throughout. The main travelling wheel is also lighter than usual. It is fitted with a removable malleable bush, which houses the two roller bearings. The transmission of power from the main wheel to the chain wheel is direct. All the sprocket wheels driven by the back elevator chain are provided with roller bearings and similar bearings are fitted to both ends of the inside platform roller. Thrust ball bearings are used in the main wheel, the first motion spindle and the second motion spindle. To accommodate the thrust on the main drive pinion a ball race is placed behind it, and it tends to keep the second motion spindle in position. For tightening the bottom canvas there is a rack and pinion movement at both ends, operated by a handle underneath the back board and acting on a ratchet and pawl. The elevator is designed so that it can deal with anything the binder can cut without becoming congested. The frame is a rigid fixture braced and stayed to secure correct alignment of the canvases, and the rollers float on strong springs. A device is provided for releasing the tension of the canvas when not at work. The knotting mechanism has been improved in detail and a string guide has been introduced to work in association with the knife to provide a scissor-like cut.

A new root thinner, which T. B. Russell & Co., Ltd., Kirbymoorside, exhibited, is constructed on an entirely new principle, the hoeing mechanism being attached to the travelling wheel without the intervention of gearing. The hoes are pivotally attached to the hub of the road wheel and are only operated at the bottom centre, thus following the inequalities of the ground with the road wheel. The hoes can also be regulated are regards depth by means of a screw and worm wheel. The machine will work on various widths of rows and the hoes can be raised clear of the ground for transport purposes, but no means are provided for altering the spacing of the hoes. The machine is light in draught, being well within the power of one horse.

Richard Garrett and Sons, Ltd., Leiston, were represented by an undertype steam wagon for 8-ton loads, a 54in. finishing threshing machine fitted with ball bearings to all quick running spindles, chaff-bagging apparatus, and mounted on wooden wheels, and a 30ft. light type of folding elevator.

A new machine for separating purposes, Fig. 20, was shown by Mr. John Wilder, of Reading. It is specially designed for separating the meal from the pips after the locust bean has been broken, and may also be used for separating by the dry process the kernel from the broken shells of palm nuts. The machine's construction is diagrammatically shown in Fig. 21, and it is claimed that the method used is quite new, flexible metallic "carpets" being the essential medium adopted. The machines deal with the material in a continuous stream, and by means of chutes deliver it ready for bagging. In the illustration M M^1 are the endless flexible metallic carpets and Q Q^1 are baffle plates. The carpets are composed of a canvas backing into which have been closely woven strands of spring steel wire, the ends of which stand up at a particular angle. The wires are afterwards ground so that they present a rough surface in the direction of travel. This surface, when adjusted to the correct angle, allows smooth objects to slide down, while all material of irregular shape is held by the rough carpet and so carried up and separated. The inclination of the carpets is an important factor of the process. Adjustment is obtained by means of the sliding brackets P which permit the wide angular movement called for by the various materials. The material is fed in a thin even stream from the hopper F, the rate of feed being controlled by the rising plate E in conjunction with the reciprocating plate D. Most of the meal or shell, &c., is retained by the carpet as it falls.

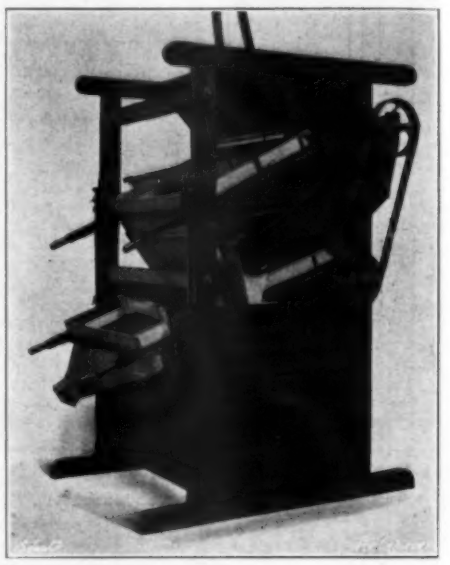


FIG. 20—SEPARATING MACHINE—WILDER

Diagonally across the carpets M and M^1 are placed the baffle plates Q Q^1 which control the passage of the material. The clearance between the surface of the carpet and plate is adjusted according to the size and shape of the pips, kernels or seeds. These, owing to their shape and texture, slide down together with a certain amount of meal or shell, pass underneath the plate over the first carpet on to a chute G to the second carpet where the separation is completed, and thence out at chute X. The meal or shell is stopped by the plates Q Q^1, which turn it over until it is caught by the rough surface, carried up and delivered with the bulk at chutes S and T. In the case of palm kernels, &c., unbroken nuts and large shells travel across the carpet to a pocket L and are ejected at the chute H for re-cracking, after having passed through a rotary sieve J, which insures that no kernels are lost.

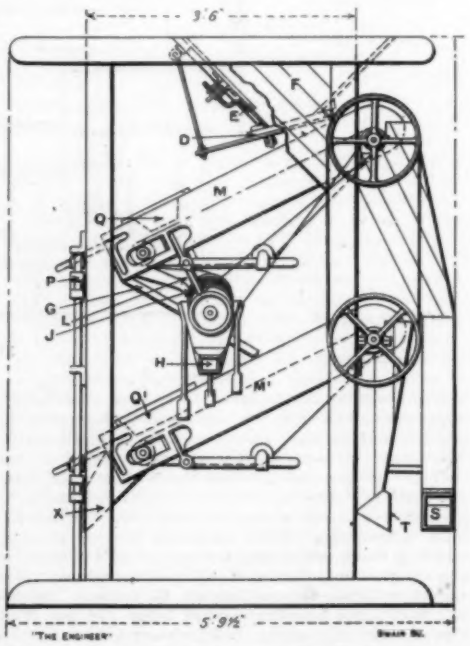


FIG. 21—DIAGRAM OF SEPARATING MACHINE—WILDER

Petters Ltd., Yeovil, as usual, made an imposing display of oil engines of various types from 1½ horse-power upwards, specially appropriate to the Show being the "Handyman" agricultural engine for petrol or paraffin, which is simple and of low first cost. The crude oil engine of the surface ignition type,

* No. II. appeared July 8th.

made in sizes from 5 to 36 horse-power, is a simple two-stroke engine, which can be started immediately from cold without pre-heating by means of the Petter cold starter, which was awarded the Society's Silver Medal at the 1923 Show. This type of engine is also made for marine purposes. The speed of these engines is controlled by a double excentric shaft governor, which regulates the quantity of fuel injected by the pump; thus an explosion is produced at every cycle, but the force of the explosion is modified in proportion to the speed and power required. A uniform and steady motion is thus produced, and "racing" in heavy seas is prevented.

Fig. 22 shows the Marshall-Benson concrete mixer,

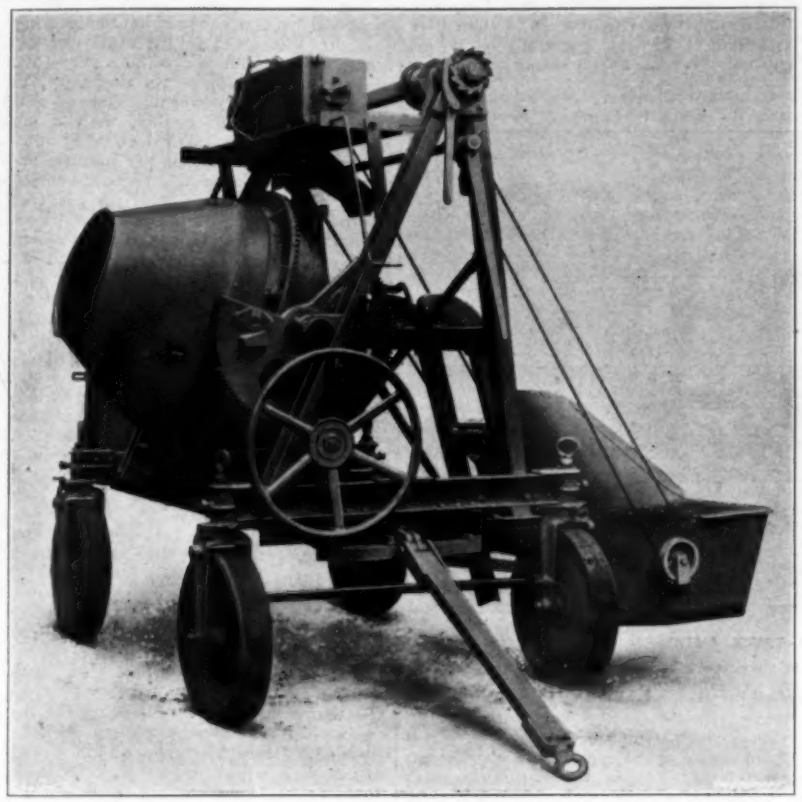


FIG. 22—THE MARSHALL-BENSON CONCRETE MIXER—MARSHALL

exhibited by Marshall, Sons and Co., Ltd., Gainsborough. This mixer has a convertible chassis constructed of steel with four large road wheels, which can be changed for direction in a few minutes by the removal of pins. To convert the machine from end to side discharging, no jacking-up or removal of wheels is necessary. The loading bucket is constructed so that there are no sharp corners in which materials are liable to stick. It has a steep angle of discharge and cannot get out of alignment. The drum with its mixer is designed to give a perfect mix of the materials without separating the aggregate, and the latter cannot clog on the bowl bottom. The shape of the drum and its method of working give a clean and rapid discharge. The drum bearings are of the roller type with ball thrusts. The bearings are positively lubricated, and are protected from dust and wet by means of covers. The gear ring, on the mixer drum, is reinforced to prevent warping, and the trunnion bearings are of large dimensions, bushed with bronze. The engine is one of Lister's vertical type and hopper cooled, designed to work on paraffin, petrol only being used for starting up. One lever only controls the clutch and brake for the loader bucket and another lever operates the water tank. The drum can be swung by means of a hand wheel, and the toothed sector wheel seen in the illustration, positive stops being provided at the charging, mixing and discharging positions. A spring wheel is provided to release the drum from the mixing position. The apron chute, which is hinged to the machine, is easily detachable, and gives a smooth surface from which to shovel the discharged contents from the mixer bowl. The chute can be hinged up and fastened to the A frame of the machine for travelling purposes. Messrs. Marshalls also exhibited a smaller machine intended for builders and estate work. It is operated by 1½ brake horse-power petrol engine.

In addition to purely agricultural implements, Blackstone and Co., Ltd., showed a range of oil and petrol engines which cover a wide field of operations. Amongst hopper-cooled engines there were two of 10 brake horse-power running on crude oil with spring injection, the first of this type to be built in this country we are informed. These engines are semi-portable and self-contained. A 35 brake horse-power engine with spring injection for running on Diesel oils was also a feature of the stand. All the above-mentioned engines differ from the standard spring-injection type in the design of their cylinders; the bore being larger they work with lower pressures, run at higher speeds and have a larger power output. A petrol engine of new design is shown in two sizes, 3 and 4 B.H.P. This is a four-stroke engine with high-tension magneto, and there are some new features in its design. The carburetter is fitted with mechanism which automatically adjusts the mixture, both as to quantity and quality for all loads. The engine has overhead valves and detachable head, and there is an indicator for the lubrication system. Another exhibit we noticed was a combined petrol engine and compressor for charging the compressed air bottles for starting oil engines. The complete unit consists of a 4½ B.H.P. horizontal two-stroke petrol engine, and a two-stage vertical air compressor operated from the same crank pin. The same tank is used for cooling the water circulating in the compressor and engine jackets.

Barford and Perkins, Ltd., of Peterborough, exhibited for the first time a new three-wheel 8-10-ton motor roller. This roller, which is illustrated in Fig. 23, is constructed to allow for the weight to be varied by means of water ballast. The back and front rollers are filled through 2in. filling plug openings in the end, and in conjunction with the sprinkling water tank, a weight variation of nearly 2 tons is obtained. The distribution of the weight can be varied. For instance, when working on steep hills of 1 in 7 to 1 in 5 it is advantageous to reduce the weight on the front rollers and increase the weight on the back. This increases the adhesion of the driving roller and reduces the resistance in front. The back rollers have renewable cast iron rims and hubs and plate ends machined to fit in the rims and hubs, so as to take the shear load from the bolts and reduce the risk of breaking the spokes, a risk which was run with the older forms of driving wheels. The frame of the roller, which is of exceptional strength, is of box girder form, a heavy sub-frame forming the bottom member, the tanks and head the top member, and the side plates forming the sides of the girder. The engine and entire transmission are carried on the sub-frame, and can be removed from the rest of the chassis as a unit.

With this construction, the makers point out, an attached scarifier can be fitted without any risk of damaging stresses being transmitted to the engine or gearing. The scarifier is bolted direct to the side plate on the near side. A 25–28 B.H.P. four-cylinder engine, 3⅞in. bore by 5in. stroke, is fitted at the rear of the chassis, where it is very accessible for minor adjustments, it being only necessary to lift the bonnet to effect them. If an overhaul of the engine is required the engine can be removed entirely without disturbing the transmission mechanism. The power is transmitted through a single plate clutch with fabric friction linings, and a flexible coupling to a three-speed gear-box. Three speeds are provided in each direction, giving road speeds of 1¼, 2½ and 4 miles per hour. A great convenience in country districts or abroad is the large fuel capacity of this roller, a fuel storage tank of 30 gallons capacity being provided, in addition to a 6–8-gallon service tank, or sufficient fuel for over seven days normal working. Either petrol or paraffin can be used, a vaporiser being fitted for the latter fuel. The engine is started on petrol, and in three to five minutes the driver is able to turn on paraffin by means of a three-way cock conveniently placed in front of him. The driving rollers are 5ft. diameter by 15in. wide, and the front rollers 3ft. 6in. diameter, with a total width of 4ft. 2in., thus overlapping the inside edge of the driving rollers by 4in. each side. This firm also showed a lighter motor roller with interchangeable cast iron back rollers.

The exhibits of Clayton and Shuttleworth, Ltd., included a 15 brake horse-power hot-bulb crude oil engine, designed for driving a dynamo; a 20 brake horse-power engine of similar type, for industrial purposes; a 4ft. 6in. finishing threshing machine; a portable steam engine; and two 6-ton steam wagons of the overtype and undertype. The chief features of the hot-bulb engine include simplicity of construction, low maintenance cost, efficient governing on the excentric principle, an enclosed crank case with an easily removable cover, and low fuel consumption. The 6-ton undertype steam wagon has piston valves and an improved valve control gear which permits the driver to adjust the cut-off from one-quarter to three-quarters of the stroke from his seat. The engine is totally enclosed, and runs in an oil bath, while an inspection door of large size is fitted on the crank case and exposes the whole of the main bearings and crank shaft motion for inspection. The overtype steam wagon has three-speed gear, Ackerman steerage and four wheel brakes, the latter being, we are informed, unique in connection with this type of vehicle. In the boiler, both the heating and grate surface have

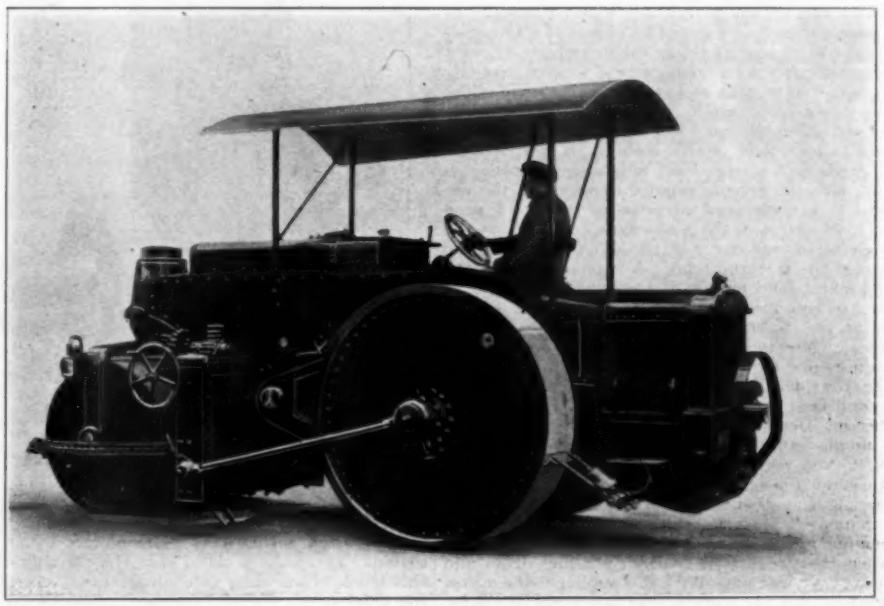


FIG. 23—THREE-WHEEL 8-10 TON MOTOR ROLLER WITH SCARIFIER—BARFORD AND PERKINS

been increased by 30 per cent., and the working pressure has been raised to 230 lb. per square inch. The crank shaft runs in ball and roller bearings and similar bearings have been fitted to the front axle. The 4ft. 6in. threshing machine has wrought iron travelling wheels and a specially constructed frame fitted with a two-string type straw trusser with raising and lowering gear. Ball bearings are fitted to the fast-running shafts, and the other features common to this firm's machines which are included are a divided blast, a double adjustable rotary corn screen, reversible concaves, a 22in. iron and steel drum, chaff-sifting apparatus, an inside cup corn elevator, &c.

In the new potato digger, for which Messrs. Howard, of Bedford, have received a Silver Medal, the working parts consist essentially of a loosening share and two semi-horizontal tine wheels. The first tine wheel, with vertical tines in pairs, rotates slowly behind the loosening share, and a second tine wheel with horizontal backward curved tines rotates at a slightly

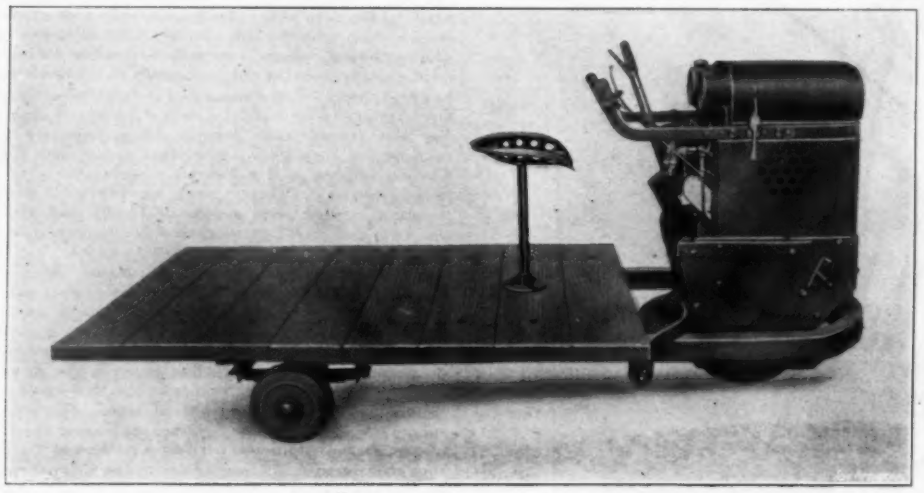


FIG. 24—PETROL ENGINE DRIVEN AUTO-TRUCK—LISTER

higher speed, so as to deliver the crop to the rear of the machine. The loosening share can be set to any desired depth and at varying distances from the vertical tines, whilst maintaining the correct cutting angle. The first tine wheel is driven through bevel gears by a sprocket wheel and chain from the main axle and the sprocket wheels can be changed to give any desired speed of rotation. The depth at which the vertical tines work is adjustable. The second tine wheel is driven off the same sprocket as the first wheel, but at a higher speed. The tines on this wheel can also be adjusted for height. They are made of round bar, curved and bent backwards, so as not to damage the potatoes. The distance between the first and second tine wheels can be varied several inches in order to obtain the best results for different crops. All the gear wheels are high up and are protected by guards.

On the stand of E. R. and F. Turner, Ltd., of Ipswich, was shown a Bull arc welding plant. In this plant current is generated by means of a 12 horse-power four-cylinder Dorman engine, which drives a reverse-compounded dynamo wound to give drooping voltage characteristics, so as to ensure stability of the arc and ease of operation without the use of resistances in the arc circuit. Separate excitation of the dynamo shunt field effects stability of the voltage at all loads and a large load resistance reactance in the arc circuit prevents rapid fluctuation of the arc current. A seven-stud diverter is employed in a series field circuit of the main dynamo to adjust the load characteristic curve of the dynamo to suit the nature of the work in hand. A regulator is inserted in the shunt field circuit of the dynamo to allow of control of the open circuit voltage and final adjustment at the lighter loads when close regulation is essential. Messrs. Turner also showed flour-milling machinery and corn crushers.

The Herridge "Simplex" drainage excavator for mole and land drainage, for which Mr. E. V. Twose, Halberton, Devon, was awarded a Silver Medal, is a very simple device consisting of a steel L-shaped cutting share to the rear of which is connected a wooden wedge-shaped sleigh or elevator with two guides for depositing the dredged materials on either side of the trench. The share is drawn along by a 4 H.P. oil engine mounted on a portable oak framework, together with reduction gearing, winding drum and 100 yards of wire rope. With this appliance the maker informs us that two men can cut 300 yards of drains, measuring 24in. deep by 10in. wide at the top and 7in. wide at the bottom in a day, with an expenditure of 2 gallons of petrol.

An improved hay-making machine was shown by W. N. Nicholson and Sons, Ltd., Newark-on-Trent. The chief feature of this new machine is that the gearing is enclosed in a water-tight gear-box, in which there are no holes, except oil holes, to afford an entry for hay and seeds. The fork bars are put into and out of gear by means of a single lever, which controls the forward and reverse actions, and also the out-of-gear position, while providing a ratchet escapement, leaving the forks free to revolve and clear themselves of hay.

R. A. Lister and Co., Ltd., Dursley, Glos., had on exhibition a new model of a petrol engine which has been designed to meet the demand for a small power unit suitable for driving many machines which would otherwise be operated by hand power. A view of this engine is given in Fig. 25, from which it will be seen that the design is very neat, all projecting parts being eliminated. A four-stroke engine with cylinder 3in. stroke by 3in. bore, developing 1½ horse-power at 700 revolutions per minute, it has overhead valves with enclosed valve operating gear, an inlet valve masked to give quick opening and high efficiency. The combustion chamber is designed to obviate "knocking." Throttle governing by means of a butterfly valve operated by a sensitive governor and controlled by the load on the engine is employed. The carburetter is floatless, and is fitted with an automatic air valve, which regulates the mixture to suit the load. Lubrication of the crank shaft, connecting-rod bearings, piston, &c., is automatic. Another exhibit by this firm is an auto-truck, shown in Fig. 24. This is a very handy little truck, operated by an air-cooled petrol engine, which runs on three wheels, and has its platform only 14in. from the ground. It can turn in a radius less than its own length, and can be reversed without the aid of any gearing, the combined power and steering unit being capable of swinging round in a chassis frame. All the moving parts are on ball bearings which permit of the truck

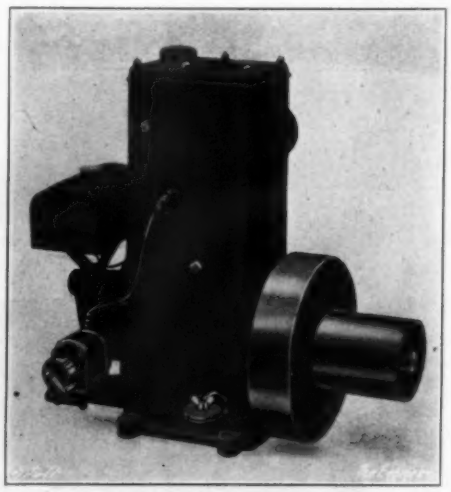


FIG. 25—1½ H.P. PETROL ENGINE—LISTER

to be pushed with ease by one man when fully loaded. Brakes are fitted on all the wheels, and there is a safety switch within easy reach of the driver when seated. The makers claim that the running cost of this truck is less than three-quarters of a penny per ton mile.

Robert Boby, Ltd., Bury St. Edmunds, exhibited a flax-pulling machine, a description of which was given in our review of the Show last year. This firm also showed a new domestic refrigerator of compact design, in which the cooling medium is automatically circulated by means of an electric motor.

Fielding and Platt, Ltd., Gloucester, exhibited standard productions in the form of three four-stroke hot-bulb oil engines of 52 B.H.P., 30 B.H.P. and 18 B.H.P. One of the claims made by the makers of these engines is that the pressures employed are only those of the ordinary gas engine, and that up to 100 horse-power engines of this kind can be readily started by hand without any starter, should the air pressure required for starting be lost.

Ransomes, Sims and Jefferies, Ltd., Ipswich, had two stands, one being devoted to lawn mowers and the other to agricultural implements, some of which were shown operated by electric motors. The 6 nominal horse-power traction engine shown by this firm is fitted with springs to both axles and an injector. Ploughs suitable for animal and mechanical traction, a tractor mole drainer, various types of cultivators and potato diggers of standard construction, contributed to make an imposing exhibition.

The "Lanz bull-dog" heavy oil tractor which was exhibited by the Locomobile Engineering Company, Ltd., 57, Victoria-street, Westminster, is of German origin. This machine created a very favourable impression on account of its simplicity, rigidity and accessibility. The power unit consists of a horizontal two-stroke hot-bulb engine, with a spring-loaded shaft governor capable of developing 22 brake horse-power at 500 revolutions per minute, or 28 B.H.P. overload. All the working parts are enclosed in dust-proof oil-tight casings, and air for combustion is filtered and rendered dust-free before entering the cylinder. The engine is started by means of a blow lamp or charcoal heating device, and is fitted with automatic forced lubrication. Power is transmitted to a four-speed gear-box by means of a clutch and flexible coupling, and the travelling speeds for ploughing are 2, 3, 4 and 5 miles per hour. The engine being reversible, allows of the four speeds being available in either direction of travel, and the engine can be reversed without the driver having to leave his seat. The machine is steered on the Ackermann principle, and there are two transmission brakes, one operated by hand and the other by foot, as well as a clutch brake. The final transmission to the live axle is through gearing and a differential. For stationary work there is a 27in. pulley on an extension of the crank shaft. We are informed that the draw bar pull when operating on the first speed with standard wheels fitted with strakes is between 2200 lb. and 2650 lb., and with single rubber-tired wheels 2100 lb. The leading dimensions of the tractor are:—Extreme length, 10ft. 6in.; width, 5ft. 5in.; and height to the top of the exhaust pipe, 6ft. 11in.; the turning circle is 26ft. diameter; the wheel base, 5ft. 10in.; the width of track, 4ft. 5in.; and the net weight, 2¾ tons. The figures for fuel consumption for deep ploughing with a two-furrow plough which have been supplied by the exhibitors are 18 lb. to 22 lb. of crude oil per acre, while for belt work the consumption is stated to be 1¼ gallons per hour. Subject to tests, which are to be conducted by the judges of the Royal Agricultural Society, this engine has been awarded a Silver Medal.

In addition to the awards already mentioned medals have also been awarded to:—McBain Brothers, Ltd., of Berwick-on-Tweed, for an electric wind motor; Mr. Joseph, of Cleveland Gardens, Hyde Park, London, for a new form of agricultural tractor wheel; the United National Engineering Company, of Cardiff, for a bottle-filling machine, and to Cascoigne's Ltd., of Reading, for a new milking machine.

The Show came to an end on Saturday last, and it is feared that the Society will have made a heavy financial loss, for the total attendance for the five days was only between sixty-two and sixty-three thousand, far smaller than that at Reading last year, when the loss exceeded £6000. Although bad weather had something to do with this poor result, other causes contributed to it, and not the least was the depression in trade, from which South Wales has not escaped. We were prepared for some such result as was actually experienced, and sympathise with the large body of exhibitors in the implement section, which from year to year throws in its lot with the Royal Agricultural Society—frequently with little expectation of direct financial benefit—in order to demonstrate to agriculturists the world over what Britain can accomplish in this connection. It is to be hoped that the losses of this year will be more than recouped when the Show is held next year at Nottingham.

PYROMETALLURGY is now the only practical method in vogue for extracting metallic manganese from its ores, says the United States Bureau of Mines, in Information Circular 6034. As manganese is highly volatile at the temperature required to reduce it to the metallic state, smelting losses are extremely high, and materially increase the cost of the reduced metal. To produce metallic manganese, the ore must be smelted at a high temperature and a strong reducing action maintained. As this method reduces any iron in the ore, the resultant metal is an alloy of manganese and iron. The Goldschmidt process, which is based upon thermit action, is now used to produce metallic manganese. In it, pure manganomanganic oxide mixed with aluminium is used. The powdered aluminium is incorporated with the oxide and the mixture is brought to the required temperature. The amount of aluminium used is based on the total oxygen content of the purified manganese oxide, and is sufficient to produce sesquioxide of aluminium.

Institution of Naval Architects.

No. I.

SUMMER MEETING IN CAMBRIDGE.

THE summer meeting of the Institution of Naval Architects was held in Cambridge from Tuesday last till to-day, under the presidency of His Grace the Duke of Northumberland.

There was an attendance of members and ladies numbering some 120 when the Rev. G. A. Weekes, Vice-Chancellor of the University, welcomed the Institution in the Senate House on Tuesday morning, July 12th. The Vice-Chancellor said it was highly appropriate that the Institution should have chosen the ancient seaport town of Cambridge for its summer meeting, and, in reply to the laughter at this remark, he explained that according to the historians, Cambridge in the ninth and tenth centuries, when the Danes held it, was a port of considerable consequence. In any gathering of old Cambridge men, however, almost every profession in the world was represented, with the exception of the naval profession. It was very unusual indeed to find any naval men among old Cambridge men. It was true that there was a Chair of Naval History in the University, though there was no Chair of Naval Architecture, but the visitors would find in the Engineering Department a place where they would all be at home, and he hoped they would be interested in observing the great progress which that school had made during the past twenty years. He was struck by the width of the field which the Institution covered. The members were not content simply with dealing with matters concerning the construction and equipment of ships, but were also prepared to descend to antiquarian pursuits, and even condescended to deal with the propulsive efficiency of rowing. They had come, probably without knowing it, into a place where controversy had been raging between two schools of rowing. There was what was called the orthodox school, and there was the newer school, which at present had no fixed name, but which had attained very considerable success over short courses. The ultimate results, however, as between the two schools of rowing had yet to be proved. Whether the new would be equally successful over a long course, and whether its effect on the physique and constitution of those who took part in it would be as good as that of the old system, remained to be seen. In conclusion, the Vice-Chancellor expressed the hope that during their visit those attending the meeting would find time to visit some of the beauties of the town and University.

The President, in expressing the thanks of the Institution for the welcome offered by the Vice-Chancellor, said that it had been the habit of Cambridge University for many years to extend a warm welcome during the long vacation to learned societies and other bodies engaged in the advancement of higher education, but there had not, he believed, been any previous gathering in Cambridge of those whose special line of work in applied science had been connected with that great and British industry, the building of ships. Cambridge possessed an unique feature among college libraries in that extremely interesting collection of books brought together and reverently preserved for posterity in the buildings of Magdalene College—the Pepys' Collection—which that remarkable secretary of the Navy, collector, diarist and man of the world spent many years in acquiring. That possession in itself would be a sufficient reason for identifying Cambridge University in a very special way with the art of shipbuilding, and it was for that reason that the Council of the Institution had placed first on the list of papers to be read at this meeting one by Mr. Laird Clowes, son of Sir William Laird Clowes, whose brilliant writings and research entitled him to a high place among our naval historians. Cambridge, however, had another and greater claim to respect and admiration on the part of naval architects; it was, *par excellence*, the acknowledged fountain head of learning in higher mathematics, and all scientific progress, to be effective, must be based upon sound mathematical principles. In no branch of applied science did mathematics play a larger part than in ship design. Naval architects, therefore, must feel a peculiar sense of gratitude towards that centre of learning from which so much mathematical knowledge had sprung and radiated far and wide during the course of centuries. Newton, friend of Pepys, who matriculated at Trinity College on July 8th, 1661, and subsequently held the Chair of Mathematics in Cambridge University, and the bicentenary of whose death was so recently celebrated at Grantham, might be looked upon as the father of modern mathematical science. His name had rightly been handed down to posterity as one who laid down fundamental principles upon which subsequent practice had been based. The tradition which thus started in the time of Newton had been carried on ever since, and in the latter half of last century alone, Adams, the astronomer; Stokes and Cayley, the mathematicians; Kelvin, the physicist and electrical engineer, and the late Lord Raleigh stood out among the leaders in the realms of pure and applied science. Coming down to the present day, we had the distinguished Master of Trinity College, Sir J. J. Thomson, whose life work had been for the advancement of science and the dissemination of knowledge; Sir Richard Glazebrook, formerly Director of the National Physical Laboratory, during whose period of office there the William Froude Tank, endowed by Sir Alfred Yarrow, was started, and had since been of such inestimable value to the study of ship resistance; Sir Ernest Rutherford, President of the Royal Society, and Sir Charles Parsons, in whose undergraduate days were sown not the wild oats of thoughtless youth but the seeds of that great industrial plant, the steam turbine, which had from small beginnings grown to be so great a power among the world's prime movers.

Continuing, the President said that the study of engineering at Cambridge University had received great attention in recent years, and a tremendous impetus as the result of post-war conditions. The growth of the engineering department, under the successive leadership of such distinguished professors as Sir Alfred Ewing, W. E. Dalby, Bertram Hopkinson, and C. E. Inglis, had been one of the most noteworthy features in the modern history of that ancient university, and the mere growth in numbers was significant of its rapid progress. The first Tripos examination took place in 1894, when the number of students was only 80. That number rose to 270 in 1914 when war broke out, and put an end for the time being to all engineering activity within the University. After the war, however, there came a rush for admission, and the numbers rose in 1920 to 800, when the question of accommodation became acute. To-day about 450 students were engaged in engineering, and their work was bearing fruit in many branches of applied science. The University Appointments Board had a record of twenty-five years' excellent service to its credit, and had been instrumental in finding occupation for a large number of University graduates. In engineering alone, 420 had been placed during the period 1921–26. In 1925-26 out of 667 graduates who registered with the Appointments Board, 400 obtained appointments, these latter figures relating, of course, to other branches as well as engineering. It would be seen from these few figures what striking success had attended the educational policy now pursued in Cambridge, and the Institution of Naval Architects, which claimed representatives from most of the universities where engineering was taught, could offer congratulations to that ancient foundation which had comparatively recently entered that field of modern educational activity.

Another bond of union between the University and the Institution during the war and for some time after was the admission of a number of naval cadets who were specially drafted to Cambridge for a short course of intensive study in various specialised branches of science. The results obtained were highly satisfactory, and those young naval officers would look back upon their Cambridge days with a happy recollection of their social amenities and professional usefulness in after life.

One of the objects in holding the present summer meeting in Cambridge was to give opportunity for those who directed the educational forces of the country into channels such as shipbuilding and marine engineering to come into touch with those who had to carry out the work of designing and building ships and engines, and in that he hoped the present meeting would be thoroughly successful. But the Institution also welcomed that opportunity of paying its tribute to the great fame and high tradition of the noble University and its admiration for the splendid achievements of that University in all those branches of science which throughout long centuries had materially assisted in the progress and development of mankind.

The first paper, namely, "Ships from Pepys's Manuscripts," by Mr. G. S. Laird Clowes, of which the following is a short summary, was then read.

SHIPS FROM PEPYS'S MANUSCRIPTS.

This paper is appropriate to the visit of the Institution of Naval Architects to Cambridge, since it deals with some of the earlier naval documents—mostly hitherto unpublished—which are to be found in Pepysian Library at Magdalene College, Cambridge. A notable volume referred to by the author is Anthony Anthony's Roll of 1546, which was presented to Samuel Pepys in 1680 by King Charles II., and deals with the ships of King Henry VIII. Unfortunately, however, this record gives no dimensions, but only the tonnage of each ship. Another important manuscript which is freely cited and from which several excellent illustrations have been reproduced, is the volume which was termed by its owner "Fragments of Ancient English Shipwrightry." It contains 150 pages, with detailed information as to the best way of proportioning and of laying-out the various parts of a ship. Although undated, there are indications which suggest that William Baker, who was shipwright for the Vangard, built in 1586, may well have been the author of the book.

Mr. Laird Clowes discusses and compares several of the draughts or plans of ships given in "Ancient Shipwrightry," and shows what advance was made during the Elizabethan period. He then goes on to deal with the development in naval shipbuilding which took place under the early Stuarts, the Commonwealth and the Restoration periods, which are all referred to in various records to be found in the Pepysian Library. Two important volumes are those of Sir Anthony Deane, a master shipwright, who presented his manuscript, entitled "Doctrine of Naval Architecture" to Pepys in 1670, and Battine, who followed suit with his "Method of Shipbuilding" in 1684.

For purposes of comparison the author gives the following short table, which shows the dimensions of ships, both from draughts and from ships actually built, in the reigns of Elizabeth and Charles II. All the vessels chosen were of about 800 tons burden. The draught from "Ancient Shipwrightry" is representative of the majority of the designs given in that manuscript. The Triumph represents one of the shorter of the large Elizabethan ships, and the Merhonour a more advanced Tudor type. The Resolution, built by Deane, has been chosen as most closely corresponding to the only complete draught given in his "Doctrine of Naval Architecture."

Table of Comparative Ship Dimensions.

Date of ship.	Length of keel.	Beam.	Depth of hold.	Rake forward	Rake aft.	Length between perpendiculars.
	Feet.	Feet.	Feet.	Feet.	Feet	Feet.
Draught from "Ancient Shipwrightry" ..	100	40	20	28	12	140
Triumph, 1561, rebuilt 1595–96	100	40	19	37	6·0	143
Merhonour, 1590	110	37	17	37	6·5	153·5
Resolution, 1667	120·5	37·2	15·5	—	—	—
Deane's draught 1670	120	36	16 about	27	6	153

The improvements shown in these ships are discussed. In conclusion, the author recalls that until recently our detailed knowledge of the design of ships has gone no further back than the restoration of the monarchy, and for earlier periods we have been depending on comparatively isolated statements. This, he remarks, is still the case, for periods anterior to the middle of the sixteenth century, but all experience goes to show that the more detailed our knowledge, the smoother and more gradual proves to have been the path of progress.

Sir John Biles, who opened the discussion, said that the paper was extremely interesting, although a little off the beaten track of the subjects usually presented to the Institution, and therefore might not lend itself quite so readily to discussion. The dimensions of the ships shown in the paper must be new and interesting to many. For instance, it was pointed out that vessels 100ft. long with 40ft. beam were the great ships of those days. Looking at one of the drawings in the paper it was interesting to note the enormous size of the pair of compasses used by the designers, and the small size of the men depicted in the same illustration. Looking at the structures of the ships shown in the drawings, it would appear that in the early days of Elizabethan ships they must have been less strong than they should have been, because the scantlings did not appear to be what we should regard as sufficient for ships of such dimensions in our time. Perhaps that accounted for the fact that some of those vessels did not last as long as later ships. Another interesting point was that the pillars in those ships were shown in the drawings diagonal. He himself had often thought that our system of vertical pillars was not the best for meeting the stresses encountered by a rolling ship.

Mr. W. H. Whiting, after commenting upon the fact that there are still two big gaps to be filled in our knowledge of naval history, comprising, first, the whole history of the early Tudor monarch, and, secondly, the gap between the time of Elizabeth and Charles II., asked the author whether the roll of the Anthony Anthonys had been published, or was likely to be published, because a detailed perusal of that list might possibly throw some light on some of the types of the Navy at that time. As regarded the author's reference to Matthew Baker, could he say whether there was any close relationship between him and James Baker of Henry VIII.'s time, Matthew Baker being one of the three master shipbuilders appointed by Elizabeth in 1572? James Baker was the man selected by Henry VIII. to put big guns into merchant ship's hulls, some of the guns being obtained from the Continent and some from England. The problem of putting these heavy guns into what Sir John Biles had referred to as comparatively weak structures was overcome, according to Professor Buchanan's history of the Navy by fighting these muzzle-loading guns through port-holes much lower down than before, only a few inches above the water. According to the author, the differences between the ships built in the Elizabethan time and in the Charles II. period were not so big as people had sometimes imagined, but, in his opinion, the differences were even greater. Sir John Biles had commented upon the large pair of compasses and the relatively small men shown in one of the drawings, but he was inclined to think that they were to scale. The only tools used for the designing of ships were huge pairs of compasses and small set-squares, and that could be explained by the fact that vessels of that period consisted largely of circular curves joined up by a larger one or in some cases prolonged by straight lines. In the course of time the parabolic shape was

evolved, and persisted right to the end of wooden ships, and, of course, persisted to-day in so far as the curvature of the sections gradually changes throughout the length, so that a difference in form is obtained. The necessity for carrying big broadside guns necessitated the construction of vessels of a more solid or perhaps more stolid character. On the whole, therefore, he was inclined to think, from a study of the history, that there were greater differences during that period of ninety years than were suggested in the paper, and that view was confirmed by one of the Minutes of Pepys himself relating to the same period. Obviously, the question of the changes taking place during the period was one upon which there would be differences of opinion. The author, writing in 1927, thought the differences were not so serious as had been thought, whereas Pepys himself, writing 240 years earlier, thought they were greater. If only Mr. Matthew Baker had left a record of his recollections in the same way that Pepys had, it would no doubt have thrown considerable light on the development of our wooden ships. However, whatever might be said on that point, the Institution was deeply grateful for the paper.

Professor William Hovgaard, after mentioning the difficulty of obtaining a real perspective of the position of ship development, drew attention to the collection of naval models at the Royal Dockyard in Copenhagen, which, he said, although not so complete as some other collections—including that at South Kensington—was extremely interesting, and went back several centuries, although he was not quite sure that it included the Elizabethan period. A feature of the models was their extreme accuracy of detail.

Professor J. R. Jack said that history had been described as the art of inaccuracy and misrepresentation, but whilst that might be true occasionally of general history, technical history fortunately was usually free from that criticism. Nevertheless, the records of naval history indicated that it contained some anachronisms and technical errors, and he hoped the author would continue his researches in order to put them right. For instance, in one of the plates in the paper the main yard and the main stay were absolutely parallel, and the whole drawing unworkable, because there was not a single yard which could be braced round. Similarly, in the collection of marine prints in the Massachussetts Institute of Technology there were artistic pictures showing apparently the wind blowing in two directions at the same time, because one vessel was depicted on the port tack and the other on the starboard tack at the same moment. In another case the drawing suggested either that the tiller went through the mast or the mast through the tiller.

Mr. F. J. Shepherd, speaking as a practical shipwright and referring to the point made by Sir John Biles as to the large pair of compasses shown on one of the drawings in the paper, suggested that the explanation was that the designer in those days was also the builder, and that in all probability he used the same compasses for his shear draughts that he used for striking out his timbers.

Mr. Laird Clowes, replying to the discussion, said that the last speaker's explanation of the excessive size of the compasses was interesting and had probably carried conviction to everybody present. As to the size of the man on one of the drawings, it would be seen that the height of the man was slightly larger than the distance between decks, which was generally at that period about 5ft. 6in. Therefore he did not think the man was too small, although perhaps he was a little thin. With regard to the point concerning decreased displacement mentioned by Sir John Biles, he had found that the later Stuart ships were in many ways considerably better designed than the Georgian ships of the first half of the eighteenth century, when they were built according to establishment, whereas in the latter half of the seventeenth century it was possible for each shipwright to put his best work into the ship he was building. The point as to diagonal pillaring was also interesting. It appeared in the Elizabethan ships, but in the general run of the Stuart vessels there was both diagonal and vertical pillaring. The Anthony Anthony roll had not been published *in toto*. The drawings made from the initial picture had been common ever since about 1800, and the main part of the statistics had also been published about the same date. In fact, the statistical portion had been published a number of times, but unfortunately it left out the exact information which was required as to dimensions. It did not give the size of the guns, but simply the number made of brass and the number made of iron. He had no information as to there being any direct connection between the two Bakers, but he would be inclined to assume that there was a very direct relationship. The system of designing ships by a number of circles touching at various points, mentioned by Mr. Whiting, persisted right up to 1750, the parabolic system being an introduction of the beginning of the nineteenth century.

Sir John Biles pointed out that one of the sketches showed the beam of the vessel to be 48ft. Was that correct ?

Mr. Laird Clowes said that no ships of the particular period exceeded 40ft. in beam. He had, as a matter of fact, noticed that dimension, but it could not be correct.

The President, in proposing a hearty vote of thanks to the author, said he had adopted a method in preparing the paper which might well be followed by other readers of papers. In a way, he had given, if anything, too little information, and might have given a little more. The result had been that many valuable points had been raised in the discussion, but at the same time he hoped Mr. Laird Clowes would on some future occasion find it possible to amplify the paper and tell the Institution something, not only of the developments of the ships from the time of Henry VIII. to Charles II., but from Charles II. until the close of the period of wooden ships.

A paper on "The Propulsive Efficiency of Rowing," by F. H. Alexander, was then read. A brief abstract follows :—

THE PROPULSIVE EFFICIENCY OF ROWING.

The present paper gives some results of numerical investigations made during the last few years into the scientific principles involved in the movements of oarsmen and of the boats they propel.

The work has been confined almost entirely to the study of the propulsion of the "racing eight" type of boat, such as is used in the annual University race ; but, for the purpose of this paper, comparative figures have been obtained for a more normal type as represented by a ten-oared whaleboat.

Table I. shows how the two rowing boats may be compared

TABLE I.

	"Racing eight."	Whaleboat, 10 oars.	Cross-Channel steamer.
1. Length on L.W.L., ft. ..	62·0	28·0	320·0
2. Beam, extreme, ft.	2·0	6·85	40·0
3. Displacement, tons	0·81	1·70	1,850
4. Wetted surface, sq. ft. ..	109·5	133	12,510
5. Speed, knots	10·0	6·7	22·75
6. Speed, ft.-sec.	17·0	11·33	38·4
7. Value of M	20·2	7·17	7·97
8. Value of S	11·78	8·73	7·76
9. Value of K	6·025	3·58	3·78
10. Value of L_q	1·34	1·34	1·34
11. Value of $\frac{v}{\sqrt{L}}$	1·27	1·27	1·27
12. Value of $\Delta / \left(\frac{L}{100}\right)^3$ tons	3·5	77·5	56·5
13. Resistance, lb.	77	81	87,300
14. Resistance per ton displacement, lb.	95·0	47·6	47·2
15. Resistance ratio, $\frac{\text{Frictional}}{\text{Total}}$	0·95	0·51	0·40
16. Value of C	1·162	1·662	1·469

on the systems of standardisation familiar to members of this Institution, and a third column is added to show how their respective values compare with those of a mercantile vessel of similar speed-length ratio (line 11).

Features of special interest in this table are :—

(*a*) The slenderness of form of the "eight" as shown by line 7, and perhaps more markedly by line 12.

(*b*) The attainable speed-length ratio of the whaleboat seems to be the same as that of the "eight" (lines 10 and 11).

(*c*) The high magnitude of the resistance of the "eight" in terms of displacement (line 14).

(*d*) The very small amount of residuary resistance in the case of the "eight," as shown by the ratio of frictional to total resistance (line 15). This is accounted for by the values shown in lines 7, 8, and 12.

Two of the principal differences between rowing and mechanical methods of propulsion are :—

(*a*) The intermittent nature of the propulsive forces.

(*b*) The fore and aft reciprocating movement of the whole propulsive apparatus in relation to the hull.

It will be seen that the latter feature assumes a special importance in the case of a light boat with a relatively heavy crew.

Table II. shows the weights of boats and of crews in the two

TABLE II.

	"Eight."	Whaleboat.
1. Weight of boat and equipment, lb.	260	1880
2. Weight of oarsmen, lb.	1368	1510
3. Weight of oars, lb.	72	120
4. Weight of other members of crew, lb. ..	120	300
5. Total displacement, lb.	1820	3810
6. Ratio, $\frac{\text{Oarsmen and oars}}{\text{displacement}}$	0·791	0·428
7. Length of oar inboard of thole-pin, ft. ..	3·75	2·83
8. Length of oar outboard of thole-pin, ft. ..	8·58	10·17
9. Total length of oar, ft.	12·33	13·00
10. Length of inboard lever, ft.	3·25	2·42
11. Length of outboard lever, ft.	7·87	9·33
12. Ratio, outboard to inboard	2·42	3·85
13. Angular movement of oars	80°	48°
14. Fore and aft movement of C.G. of boat, crew, and oars, due to the movements of oarsmen and oars, ft.	1·32	0·21
15. Advance made during actual stroke, ft. ..	7·6	4·35
16. Advance made during return, ft.	21·6	9·25
17. Total advance between successive strokes, ft.	29·2	13·6
18. Average speed during actual stroke, ft.-sec.	14·7	10·9
19. Average speed during return, ft.-sec. ..	18·1	11·4
20. Average speed maintained, ft.-sec.	17·0	11·33
21. Slip distance, ft.	3·30	2·54
22. Slip, per cent.	30·5	35·8
23. Duration of actual stroke, sec.	0·52	0·40
24. Duration of return, sec.	1·19	0·80
25. Duration of complete cycle, sec.	1·71	1·20
26. Number of strokes per minute	35	50

cases under consideration, and includes particulars regarding the amplitude of the movements made by the crews, the oars, and the boat.

From the table it is seen that there are great differences between the boats in the following particulars :—

(*a*) Ratio of weight of crew to weight of boat (lines 1, 2, and 6).

(*b*) Ratio of oar leverages (line 12).

(*c*) Angular movement of oars, showing the effect produced by sliding seats (line 13).

(*d*) Extent of movement of centre of gravity in relation to the boat (line 14).

(*e*) The wide variation between speeds of boat when the oars are "in water" and "out of water" in the case of the racing boat, and the small variation in the case of the whaleboat (lines 6, 18, and 19).

(*f*) The faster rate of striking in the heavy whaleboat (line 26).

A detailed explanation of the theory of the forces in action is given in an appendix, and is there accompanied by a statement of the methods employed in making the calculations.

The results of the calculations are not given as exemplifying exact conditions existing ; but it is believed that they represent existing conditions in their true proportions, and help to explain some of the phenomena observed by oarsmen. Such measurements as have been taken support that view.

Table III. contains the results of the calculations made as to the forces in action and the work performed, and states the efficiency of that work according to two different assumptions,

TABLE III.

	"Eight."	Whaleboat.
1. Speed, ft.-min.	1,020	680
2. Resistance (including allowance for windage), lb.	90	96
3. Work done per minute by resistance, ft.-lb.	91,800	65,820
4. Number of strokes per minute	35	50
5. Work done at handle per stroke, per oarsman, ft.-lb.	530	212
6. Work done at handle by crew per minute, ft.-lb.	148,400	106,000
7. Efficiency ratio (productive work), $\frac{\text{Line 3}}{\text{Line 6}}$	0·619	0·616
8. Unproductive work per cycle per oarsman, ft.-lb.	501	380
9. Unproductive work per minute by crew, ft.-lb.	140,280	190,000
10. Total work performed by crew (including unproductive work), ft.-lb.	288,680	296,000
11. Efficiency ratio (total work), $\frac{\text{Line 3}}{\text{Line 10}}$ ..	0·318	0·221

namely, that efficiency should express the ratio of useful work to the work employed directly for propulsion or, alternatively, the ratio of useful work to the total work performed by the crew. These ratios are given in lines 7 and 11 respectively.

It is seen that the horse-power developed by total work is very great. It is obtainable from line 10 and amounts to 1·09 H.P. for each man in the "eight," and to nearly 0·90 H.P. for each man in the whaleboat. It may be of interest to state that some experiments carried out upon the crew of Yale University by Dr. Yandell Henderson are stated to have shown that on an average each man developed 1½ H.P. in a four-mile race. If that be accepted, it is of interest to find how much of the power can be accounted for by the mechanical forces. The experiments referred to were made by testing the amount of oxygen required in breathing.

I was permitted to examine and analyse some of the cinematograph films of the University crews at practice and when racing. The analysis is a lengthy and laborious proceeding, as corrections have to be made for the effect of perspective and for vibrations of the motor-launch from which the pictures were taken, and I am not satisfied that the measurements taken under a microscope from the films will yield much useful information.

As regards an improvement of speed by improved design of boat, or rigging, or oars, it may be said that if possible improvements by these means are very small, then from the point of view of sport it is all to the good that efficiency should rest with the man rather than the material.

Mr. Hall Craggs, in opening the discussion, said that the paper was critical, closely analysing the author's own suggestions and principles, so that it did not leave much for others to draw special attention to. According to Mr. Alexander's very careful analysis, only half of the human force exerted by the crew from the stretcher was available at the oar handle, and of the amount available at the oar handle, only two-thirds was available to produce the necessary pressure on the thole pin. Hence, only one-third of the human force expended was available for the propulsion of the boat. He himself had also made investigations upon the slip-back mentioned by the author, which was the most important point in relation to the speed of rowing. The slip-back must be kept down for maximum speed to be obtained. The importance of that was seen in the fact that whereas with some crews the slip-back was as little as 7in., there were cases in which it was as much as 16in. On the question of the advantages of the Fairbairn system of rowing and the orthodox system of rowing, Mr. Hall Craggs suggested that the future would see a combination of the two.

Captain Rowe, a former President of the Oxford University Boating Club, said he could not understand by what means the author had carried out his elaborate calculations in the study of the relative pace of the boat at different parts of the stroke, because he did not believe running alongside a university eight in a steam launch helped very much. One could imagine a great deal, but it was very difficult to calculate at all closely the movement of a boat. The curious feature arising out of investigations that had been carried on concerning rowing in recent years was that the boat was proved to be going actually slower whilst the oars were moving through the water than during the period when they were not, a phenomenon which had been explained. As to the two schools of rowing that had been mentioned, he believed it would be found that they did not differ very much in essentials, but only in detail.

Mr. C. E. Stromeyer congratulated the author on dealing with this subject by means of the cinematograph, and expressed the hope that the results obtained would be an encouragement to others to use that instrument for similar purposes. It had occurred to him that the bending of large ships could be analysed by the taking of photographs while the ship was plunging into a sea. The result one arrived at from Mr. Alexander's paper was that if a ship was moving at varying velocities, the average resistance had to be calculated, not on the average speed, but on the average of the square of the speed, because resistance increased as the square of the speed, and a bigger resistance was obtained than if the calculation was on the average speed. That meant that the

speed with which the ship moved through the water had to be as nearly uniform as possible.

Professor P. A. Hillhouse drew on the blackboard the type of diagram obtained by Lefevre and Palliotte in their investigations mentioned in the paper, relating to the speed of the boat, the pressure of the right and left-hand oars on the rowlocks, the pressure of the foot of the man on the foot spar, and, finally, the movement of the sliding seat. The figures were obtained by means of air tubes working on small cylinders which operated pens to make a record on a strip of paper.

Mr. G. S. Baker referred to a case that had been brought to his notice of two boats of apparently similar build, one of which had never lost a race and one of which had never won a race. After a close investigation, it was found that the difference in the two boats as regards rowing results was due to a greater flexibility in the one case than in the other, and that the results in races did not depend upon the type of rowing. The less flexible boat won the races. It was, in fact, a good stiff boat.

Professor C. E. Inglis said calculations had shown that the great desideratum in rowing was to keep the fluctuations of the speed of the boat, due to the actions of the men, within the smallest possible limit. In propelling a boat a given distance there might be fluctuations of speed of 10 per cent. above and below the mean, on a course like the Putney course, that meant a difference of six lengths. Incidentally, Professor Inglis amused the rowing men present by suggesting that the cox should also have a sliding seat, because at present he always seemed to be going contrary to the action of the crew.

Mr. C. C. Mason, managing director of the Cambridge Scientific Instrument Company, said his company had designed an accelerometer which was perfectly suitable for use on rowing boats, and he exhibited a record taken of the actions of a sculler. So far he had not, he said, a record of an eight. As a rowing man, however, he would rather hesitate to put such instruments on boats because it rather suggested professionalism.

Mr. H. A. M. Napier suggested that if diagrams such as those shown by Professor Hillhouse were taken regularly they could be analysed after the manner of a steam engine indicator diagram. He added that no mention had been made either in the paper or the discussion of the effect of the rudder.

Mr. Alexander briefly replied, and the meeting closed.

A further meeting was held at 5 p.m. on Tuesday, July 12th, in the Engineering Laboratory, when Engineer-Captain J. C. Brand read a paper on "Pulverised Fuel for Marine Purposes." This paper is given in abridged form on page 75.

In connection with the reading of the paper, Captain Brand had fitted up in the meeting room a working model of the Brand system, and gave a practical demonstration of the truth of his assertion that it is impossible for powdered fuel, handled in the manner described in the paper, to explode.

PULVERISED FUEL FOR MARINE PURPOSES.

Engineer-Admiral Whaymann, who opened the discussion on the paper, said that he could fully appreciate what Captain Brand had said, that it was to the interest of the country to exploit the fuel which we possessed. If, therefore, it could be demonstrated that powdered fuel had a greater efficiency than the same fuel in the solid form and at the same time enabled us to recover some of the by-products of the coal, undoubtedly good work would have been done. He could also appreciate Captain Brand's emphasis upon the importance of atomisation of the powdered fuel, and it was also easy to understand that the more finely divided was the fuel the more easy was its final atomisation and the better the results obtained. He could not, however, help feeling that the great difficulties in regard to the use of powdered fuel on board ships were still before us. For marine purposes only the fringe of the subject had yet been touched. He was rather inclined to differ from Captain Brand as to the adoption of the system of carrying powdered fuel in bulk on board ship; he was a believer in the unit system of pulverisation, as it seemed to be the one which would give powdered fuel a better chance for marine purposes in that it would enable the ship to bunker in different ports wherever she might want to go and not at particular ports where pulverised fuel could be obtained.

Sir Charles Parsons wished the author every success in his work of developing the use of pulverised fuel for marine purposes. It had been a great success on land, but it was well known that naval people were very shy of trying a new thing. On land it was much more easy to get new ideas tried out. He would like the author to give a little more information as to the precautions to be adopted against air getting into the system when the pulverised fuel was stored in the bunkers. He understood that the products of combustion were injected into the bunkers, and he supposed that there were safety devices to show how much oxygen was present.

Captain Brand said that that was so.

Sir Charles Parsons, continuing, said that whilst CO_2 was not very dangerous, CO was very dangerous, and could not be detected by smell. It was necessary, therefore, as he understood was the case, that CO recorders should be fitted.

Mr. J. Austin congratulated the author on having given such a large amount of data on a subject new to most of the members. The paper supplied convincing evidence that pulverised fuel was a serious competitor on land, at any rate, of hard coal and also oil fuel, but before it could be satisfactorily applied to ships many points would require serious consideration. In the first place, there was the question of the supplies of pulverised fuel. If pulverised fuel was to become a serious competitor with oil, it could only be so by there being available plentiful supplies of high grade fuel at all the principal bunkering stations throughout the world. Its scope would be very much limited if it could only be obtained at one or two places in the vicinity of the world's coalfields. If it could not be obtained in that way, then vessels would have to carry their own coal pulverising plant, but in most vessels lack of space would prevent such a scheme being adopted. As to the type of boiler to be used for pulverised fuel firing, the design was somewhat fixed by the length of the path of the flame required for perfect combustion. The author had confined his experiments to the Scotch boiler probably because it was the one principally used on steamships. In order to get the length of path of flame it had been found necessary by various experimenters to build an extension of the combustion chamber on the front of the boiler for each furnace, but that extension interfered with the cleaning of the boiler tubes, the handling of the ashes, and the means of access from one part of the stokehold to another. It increased the length of the boiler and added to the weight, all bad features from the point of view of ship design. There were also possibilities of intense radiation of heat from the refractory material forming the walls of the chamber extension. About seven years ago he had seen the plant on the Erie City, and had been astonished at the enormous temperature that was given off from the combustion of pulverised fuel, notwithstanding the fact that the walls of the combustion chambers were cooled with pipes, and he had been informed that had it not been for those pipes the temperature would have been unbearable. Considering these points, the impression he had formed was that the Scotch boiler was not naturally suitable for the purpose. Perhaps the author would say whether pulverised fuel could be more satisfactorily applied to boilers of the Yarrow, Thornycroft and Babcock types. Another point of the utmost importance on board ship was safety, and it appeared that unless great care was taken in handling the pulverised fuel, there was the possibility of spontaneous combustion or explosions occurring. Taking into account the confined spaces on board ship and the high temperatures in the bunkers due to the close vicinity of the boilers, there was a greater possibility of explosions occurring than in a large and well-ventilated boiler-house on shore. Bunker fires on board ship had often occurred in the past as a result of the spontaneous combustion of coal, and it would be interesting to know whether that trouble would be more likely to arise with pulverised fuel, and whether there would, in addition, be the possibility of explosion. Another thing which might affect the safety of a ship was the possibility of the pulverised fuel in the bunkers becoming moist as a result of leakage of water into the bunkers, thereby preventing its being drawn from the bunkers and causing a loss of steam in the main boilers. In connection with the comparison with the oil-burning ship, the following points should be taken into account; whereas oil fuel was available all over the world, pulverised fuel was not. Oil could be obtained in many places at at least £1 per ton less than the price mentioned in the paper. The price for pulverised fuel seemed remarkably low. At what price did Captain Brand think pulverised fuel could be delivered on board a vessel, say, in the London or Southampton Docks? Finally, the cost of upkeep of the brickwork and boilers and the pulverised fuel handling plant would be very much greater than the cost of upkeep of oil fuel plant and boilers.

Sir John Biles said that he had taken a great deal of interest in the question, but he was not yet convinced that it would be the wisest course to carry pulverised fuel in bulk on board ship. It would be better to carry out an experiment and fit a ship with a unit pulverising plant and try the effect of the use of powdered fuel before attempting to complicate the experiment by incurring the possible dangers and difficulties of carrying the powdered fuel in bulk.

Mr. J. N. D. Heenan, speaking on the difference between land and ship work in relation to the use of pulverised fuel, said he took the very opposite view from that of Captain Brand. His impression was that ships would be working under much more uniform load conditions than land stations, although Captain Brand had suggested the contrary. For instance, when a ship left port and travelled many miles to the next port, presumably there was a constant steaming rate. On the other hand, the load on land stations was constantly varying. He knew of one small station in London where the load on the boiler would vary from 22,000 lb. of steam per hour to 2000 lb. per hour in the course of five minutes. That plant had been working on the unit system without a bin, a fact which suggested that the unit system could be applied under conditions of varying load. Again, he had been in a power station a few months ago when the demand fell from 162,000 kW at one minute to twelve o'clock, to 32,000 kW at twelve o'clock. In the case of the Scotch boiler mentioned by the author, there was a projecting space, lined with fire-brick, about 6ft. long, but he could not understand how that fire-brick could withstand the excessive temperatures there must be at that point. The author had stated that combustion was completed at about 6ft. from the burner so that combustion would be completed in the projecting chamber. Experience on land had been that with air-cooled walls, if more than 10,000 B.Th.U. were liberated per cubic foot, when carrying about 14 per cent. CO_2, the brickwork would run. That was why, on land, it was necessary to use entirely water-cooled walls. Most of the new large plants that were being installed had no brickwork whatsoever. If the brickwork ran when 10,000 B.Th.U. per cubic foot were liberated, how could it be expected to stand up to the 100,000 or 150,000 B.Th.U. per cubic foot which he imagined would be the figure in the author's case. If Captain Brand had found a brickwork that would stand up under those conditions he would very much like to have some information about it. He had tried pure carborundum blocks, but they had run.

Captain Brand, replying to the discussion, said that although the criticism had been to some extent destructive, he welcomed it. To guard against the possibility of air getting into the bunkers, they were rendered as airtight as an oil bunker. There was no difference whatever between an oil tank and a pulverised fuel bunker. They were both air-tight and both sealed. Of course, if anybody let the contents of the bunker out into the air, or if there were leaky rivets, there would be exactly the same trouble that used to be experienced with oil tanks; no more and no less. Therefore, the system must be, and could be, as gas-tight as an oil fuel system. He agreed with Sir Charles Parsons as to the danger from CO through lack of smell and the necessity for guarding against leakage. Thus it was that recorders were necessary. As regarded Mr. Austin's comments concerning the use of the unit system or carrying pulverised fuel in bulk, Captain Brand recalled that in giving his paper he had stated that it was for the shipowner to decide which was the better method, according to the work the ship had to do. He personally expressed no preference. He was not against the unit pulveriser, as such, but he was against it without a bin. As to the variations in power mentioned by Mr. Heenan, the variations on board ship to which he had referred related to entering or leaving a harbour, when it was often necessary to have four movements per minute, which resulted in the load varying from nothing to 100 per cent. There was no difficulty in applying powdered fuel to boilers of the Yarrow, Thornycroft or Babcock type; indeed, it was easier than applying pulverised fuel to the ordinary marine boiler with its very short combustion chamber. The suggestion that spontaneous combustion might occur was disproved by the fact that no oxygen was present. He maintained that by the system described in the paper there was no oxygen present in the bunkers containing the pulverised fuel, and as proof of that fact he stated that he had carried coal, very rich in pyrites, for five months in a bunker on board ship without any trouble. As to Mr. Heenan's remark concerning the heat transmission per cubic foot, the Fuller-Lehigh company had brought out a burner in which the transmission was very much greater than in his own case. The theory underlying the matter was that the temperature immediately at the brickwork was not the flame temperature of the furnace. The warm air, being cooler, than the products of combustion, was heavier and it took the outside path, so that it was next to the brickwork, leaving the products of combustion in the centre. That was not the case, of course, with a very big open combustion chamber, in which the length of the path was depended upon to ignite the fuel. In such circumstances there would be a ruinous transmission of heat to the wall or side of the combustion chamber, but where the products of combustion were whirling at a rapid rate, as in his case, there was the cooling effect which he had mentioned, and it prevented excoriation of the brickwork.

(To be continued.)

THE new non-stop runs, along with many other train alterations of note, began on Monday last. The 9.50 a.m. East Coast express was drawn by Flying Fox and ran from King's Cross to Newcastle, 268 miles, where it arrived on time at 3.20. The 10 a.m. from Euston to Edinburgh and Glasgow—now named The Royal Scot—was drawn by two engines throughout, which were changed at Carnforth, 236¼ miles, which station was reached eight minutes before booked time. The train ran thence to Symington, where it was divided, and the Edinburgh portion arrived in that city at 6.3 and the Glasgow section reached its destination at 6.8—twelve and seven minutes before time respectively. The corresponding non-stop up train by the West Coast passed Willesden six minutes before time, but, owing to the flooding of Primrose Hill tunnel, as the result of a severe thunderstorm in the afternoon, it was fifteen minutes late into Euston.

THE NEW KELVIN HALL OF INDUSTRIES AT GLASGOW

MR. THOMAS SOMERS, M. INST. C.E., GLASGOW, ARCHITECT AND ENGINEER

The New Kelvin Hall of Industries, Glasgow.

By W. L. SCOTT, M. Inst. C.E.

THE new Kelvin Hall of Industries at Glasgow has been built up on the site of the former structure that was destroyed by fire in July, 1925. It occupies the whole of the ground enclosed by Argyle-street, Blantyre-street, Old Dumbarton-road, and Bunhouse-road, and to allow of that, the tenement which was situated at the corner of Old Dumbarton-road and Bunhouse-road had to be demolished.

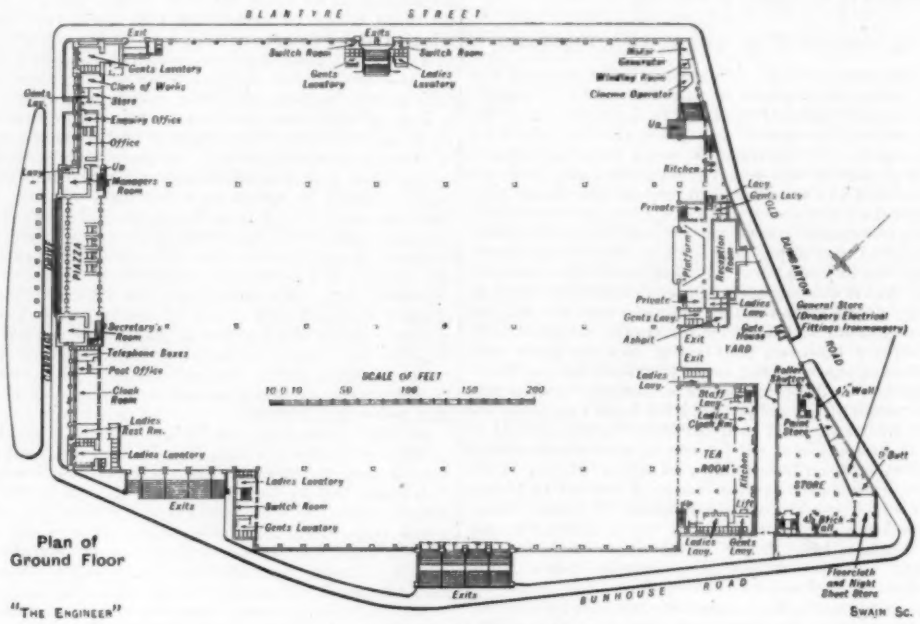
The Corporation at the outset decided that the new Kelvin Hall, which was to rise from the ashes of the old structure, must be a dignified edifice, fit to take its place in the important group of buildings in the immediate vicinity and that it must be fireproof and thoroughly equipped. To this end, the city engineer, Mr. Thomas Somers, M. Inst. C.E., was entrusted with the work of designing and supervising the erection of the new building.

The Argyle-street frontage of the new structure is set back to provide ample space on an island platform for the convenience of pedestrians on entering and leaving the building, and a carriage drive leading to a covered portico for motorists. The new hall is in three distinct portions—first, the administrative block abutting on Argyle-street; secondly, the main or exhibition hall, with its adjuncts, comprising tea-room, platform and reception-room; and thirdly, the store block, which includes the electricity sub-station on part of its lower ground floor. The general plan reproduced herewith shows clearly the accommodation provided.

The front of the administrative block, which is in red sandstone, is colonnaded on the ground floor, and for that purpose the Doric Order was employed. At each end a massive tower, surmounted by a lead-covered dome and obelisk, rises to a height of 65ft. A pillared portico occupies the lower part of the centre of the frontage, behind which rises the wall of the conference hall. Two square towers, with their vertical treatment to offset the horizontal treatment of the frontage in general, rise to a height of 100ft. Each tower terminates in a lead-covered fleche or lantern, which supports a bronze representation of the globe, symbolising the all-embracing and universal purpose of the new building. The lanterns can be illuminated at night by means of powerful lights arranged within them. The attic storeys of the wings have high-pitched roofs covered with red tiles. The half-tone engraving above gives a good idea of the exterior and shows the main frontage.

The treatment of the external walls of the main hall, which is of a simple yet effective description, was obtained by ordered fenestration and the use of bricks of various colours. The design of the doorways of the wide exits with their broad stairways expresses their secondary importance. The difficulties in designing these external walls may be understood when it is stated that the floor level of the main hall is 16ft. lower than one point of Blantyre-street and 14ft. above a portion of Bunhouse-road. There is also a fall of 28ft. in the frontage of Old Dumbarton-road.

The east wing of the administrative block affords accommodation for the management. On the ground floor of the west wing are situated the cloak room, rest room for ladies, post office, and public telephone boxes. The upper floor contains the Exhibitors' Club. In the centre of the frontage is the portico, from which, by means of a flight of six steps, entrance is gained to the piazza, with its walls and pillars of marble. Two staircases, situated behind the two main towers, lead to the conference hall, the central feature of the whole frontage. The decoration is in keeping with the important function it is to fulfil. The pilasters, architrave, frieze and cornice, are of the Ionic Order, the windows are filled with stained glass, and the floor is of polished oak.



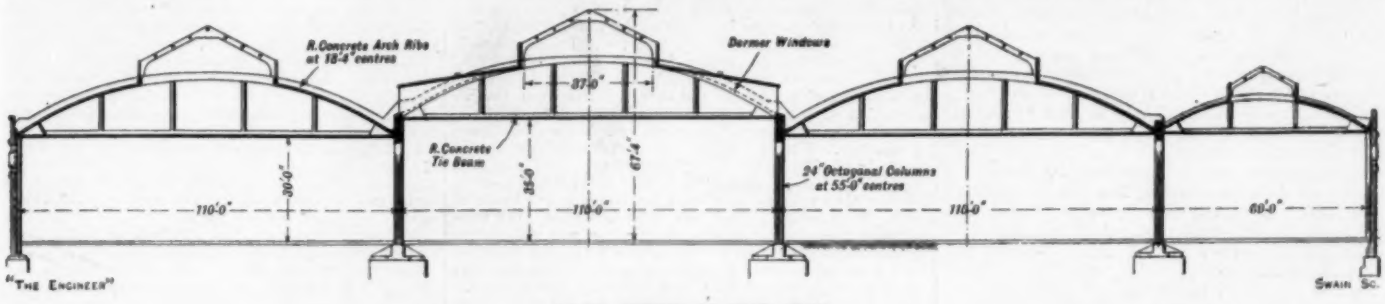
PLAN OF NEW KELVIN HALL

The east wing is probably the most up to date of its kind in existence, it is noteworthy, both on account of the size of the main hall and the type of construction employed. The area enclosed by the walls of the main hall is 171,000 square feet, and it is covered by three roof spans of 110ft. and one span of 60ft. The lengths normal to the spans are 458ft. and 331ft. respectively. For comparison, it may be stated that the exhibition space of Olympia, including the new hall—but excluding the gallery—is 212,380 square feet. The Agricultural Hall, Islington, including the annexe and arcade—but excluding the gallery—the space is 128,300 square feet.

One of the main objects which had to be kept in view when designing the roof of the main hall was to have few pillars, and these as small in sectional area as possible, compatible with strength. In this large area there are only twenty-two isolated columns. They are of reinforced concrete, and octagonal in section, 24in. in diameter. A cross section through the main hall is given in one of our illustrations. The main roof, supporting columns and foundations, together with the skeleton framework, floors and roofs

of the tea-room, stores building, &c., are of reinforced concrete, the consulting engineers for which were Considere Constructions, Ltd., of Westminster. The whole of the reinforced concrete work in the main hall is entirely detached from the surrounding builders' work.

The sizes of the various reinforced concrete members forming the roof trusses, valley beams, &c., have been kept down to the minimum consistent with safety. The entire structure of the main hall, including the external columns, gable ends, &c., is equivalent to a slab laid over the floor, 8½in. thick. This thickness does not include the external walling or foundations, the latter, of course depending upon the nature of material upon which they bear. The above figure of 8½in. is exceptionally small, having regard to the



CROSS SECTION OF MAIN HALL

height of the roof—the distance from the floor to the intrados of the centre arched span being 52ft. Moreover, the superload specified and allowed for is equivalent to a crowd of 50,000 adults standing on the roof at the same time.

In addition, the calculation of stresses in the various parts of the work had to comply with the regulations and requirements of the Dean of Guild Court. This authority, under the technical direction of the master of works and city engineer, acts in a similar capacity to that of the building department of the L.C.C., and the regulations imposed by it, although not so exacting in detail as are the existing L.C.C. regulations, are sufficiently so to ensure adequate protection of the public interests the Authority represents.

The columns are arranged in the longitudinal direction at every third truss, *i.e.*, at 55ft. centres. The maximum calculated load coming upon each of the main internal columns is 406 tons, while the actual load realised from the deadweight carried is 296 tons. The foundations of the main columns which are 55ft. apart longitudinally required special care and treatment. The foundations along Blantyre-street rest on natural stone formation, but the foundations of the other pillars had to be taken down to a low level for security, as the stone rapidly gives place to forced material, which, along the Bunhouse-road frontage, reaches to a considerable depth.

The main roof trusses are composed of arch ribs, ties, and vertical hangers or suspenders. The ribs are true arch members, the thrust being taken by the ties connecting the springings. In designing these members several important points arose. First, it was necessary carefully to consider the stresses resulting from what are usually known as "secondary effects." In spans of this size, however, these effects are certainly of first importance. These trusses are bowstring girders in the proper sense, the elastic extension of the "string" or tie inducing deformation of the "bow" or arch rib. There is a further deformation of the arch rib caused by its elastic shortening when compressed, and also that due to the shrinking of the concrete during hardening. All these effects are cumulative, and the stresses they produce are permanent throughout the life of the structure. They are therefore of vital importance in the design of such work. There is no difficulty as regards the vertical loading to be carried since the superloading can reasonably be assumed to be evenly distributed and the axis of the arch therefore made to coincide exactly with the line of pressure due to vertical loading. This was done in the case of the above roof and the curve of the soffit, although not of the usual kind, is not noticeable, owing to the elimination on the underside of the transverse projecting members.

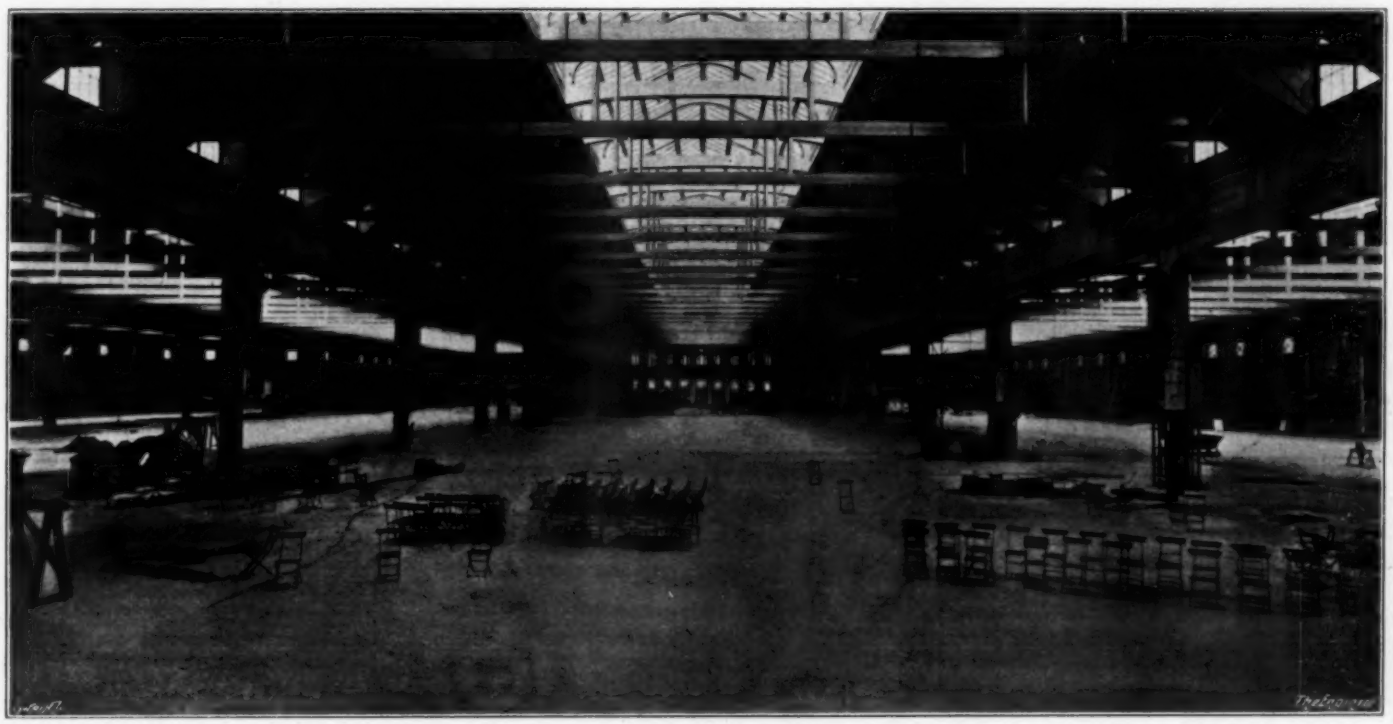
The second point of importance in such construction is the connection of the arch ribs and ties and columns at springing level. Over a relatively small area of material the entire horizontal component of the thrust from a rib, amounting in the above case to about 86 tons, has to be transmitted to the tie, while the vertical component of the thrust must be brought on to the columns without any excentricity, which, if permitted, would have the effect of introducing intense and unknown stresses at the heads of the columns. The tension in the ties is considered to be taken wholly by the steel reinforcement. That, however, does not mean that concrete embedding this reinforcement acts only as a protective cover. On the contrary, without the concrete the tie could not operate, since it was not possible practically to procure rods of sufficient length to span from end to end without a break. With a tension member of such a relatively small cross section—9in. by 13½in.—containing many rods of larger diameter, the old method of lapping the rods and terminating them with hooks was not practicable or even desirable technically. Instead, a system of butt joints for the reinforcement has been arranged in such a way that at any cross section the requisite efficient sectional area of steel is present to keep the tensile stress in the member within the prescribed limits. The main spans of 110ft. are believed to be the largest of their type yet attempted.

Special care was required during construction to obviate any undue distortion of the curved vault slab which might have resulted in unsightly, although non-structural, hair cracks appearing. It is obviously impracticable to release the whole of the staging simultaneously, and in carrying it out piecemeal, certain roof trusses are in their final condition—*i.e.*, deformed under load—whilst others remain propped, causing longitudinal bending in the concrete construction between the trusses in question.

In designing the external wall colums allowance had to be made for the lateral movements taking place at their heads as a result of the roof ties extending under stress. To facilitate the contractor's operations, the centre 110ft. span was omitted until the spans on either side were concreted. The total continuous length of the tie beams is 390ft., and, when subjected to the calculated maximum stress, the possible lateral displacement at their ends was estimated to be about 1·2in. The external colums were therefore designed to accommodate such a movement, though, in fact, such a displacement was not realised, owing to the absence of the presumed superimposed loading. Also, of course, the rigidity of the intermediate supporting columns tends to lessen the calculated movement.

In addition to the arrangement made for transverse movement, provision has also been made for expansion and contraction in the longitudinal direction of the roof. As a result of these precautions and those referred to above, no cracks of any kind have occurred in any part of this very large area of roof, which goes further to prove the suitability of reinforced concrete for work of this nature. The maintenance costs of the hall will be negligible, while the initial cost of the work compares most favourably with any other form of construction.

The quality of concrete used was 1 : 1½ : 3 for the whole of the reinforced concrete work, excepting the interior octagonal columns which were constructed with a richer mix. Upon the completion of concreting and the removal of the staging and shuttering, the interior visible concrete surfaces were rubbed down and "washed" with a mixture of white cement and



INTERIOR OF MAIN HALL

cream-coloured sand. The effect of this is to make the surfaces even in texture and pleasing in colour. No rendering in the form of plaster was permitted.

Three cupolas, 40ft. wide, and extending practically the whole length of the hall, together with a fourth cupola over the 60ft. span, give a remarkably uniform distribution of daylight over the whole area. Adequate means of natural ventilation is provided by the opening side lights of these cupolas, the dormer windows in the centre 110ft. span and the windows in the external walls. In addition, the fans which form part of the heating batteries can be employed to cool the atmosphere. The concrete roof is covered with natural rock asphalt. The floors are of concrete with a covering of natural rock asphalt for two-thirds of the area and tar-macadam for the remaining third.

The main hall, as well as all the other parts of the building, are fitted with automatic fire alarms, which are linked up to the headquarters of the Glasgow Fire Brigade. Arrangements have been made with the Post Office authorities for the permanent installation of a telephone system to which exhibitors can readily be connected on request. There is also automatic means of telephonic communication between the various parts of the building.

The Corporation, in its endeavour to make this hall as up to date as possible, has provided all the services it is anticipated will be required by stall-holders. An ample number of outlets connected to the drainage system are placed in the floor to give facilities for taking away waste water. The other services are supported along the external walls and valley beams where connections can easily be made to the gas and water pipes, and the electrical installation, the latter providing both light and power on the alternating-current system. The heating is by steam. Ample lavatory accommodation is provided throughout the building at convenient places.

The public gain access to the exhibitors' hall from the piazza, which is 90ft. long by 25ft. wide, and egress to Blantyre-street, Old Dumbarton-road and Bunhouse-road by means of broad exits and staircases. The exhibitors' goods will be brought into the hall from Old Dumbarton-road through the yard there.

The tea-room, situated at the south-west corner of the main hall, is entered directly therefrom. It measures 115ft. by 60ft. overall, and has accommodation for the public on the ground floor and on a balcony, which is reached by means of a wide staircase. The decoration is on simple yet pleasing lines.

The platform, which has an ornate proscenium, is at the south-west end of the centre 110ft. span. The reception suite adjoins the platform and is entered direct from Old Dumbarton-road. It is so arranged that, when not in use for reception purposes, it can be divided into separate apartments. There are also two platform retiring rooms. The store block is at the junction of Old Dumbarton-road and Bunhouse-road, and is on three flats, with a total floor area of approximately 20,000ft.

The building was commenced in March, 1926, and was opened by H.M. the King on Tuesday last. This period of construction included the general strike of last year, and other local industrial disturbances, all of which tended, of course, to delay the progress of the work.

The general contractors were John Train and Co., Ltd., and Edmiston Brown and Co., Ltd., were the contractors for the electrical installation and automatic telephone system, Jas. Combe and Son, Ltd., for the heating work, the Associated Fire Alarms, Ltd., for the installation of the automatic fire alarms system, and Doulton and Co., Ltd., for the sanitary fittings.

The Centenary of Fresnel.

AMONG the many distinguished men of science who during the early part of the nineteenth century filled the benches of the National Institute of France, and whose names are indelibly inscribed in the history of science, was Augustin Jean Fresnel. A civil engineer by profession, one of the many famous students of the Ecole Polytechnique, Fresnel by his work on theoretical and practical optics did more than any other in France to establish firmly the undulating theory of light, previously enunciated by Huygens and by Young, while by his invention of the "Fresnel" lens for lighthouses, he placed all succeeding generations of lighthouse engineers under a lasting debt of gratitude. He was born at Broglie, in the department of Eure, on May 10th, 1788, and died at Ville d'Avray, near Paris, on July 14th, 1827, just a hundred years ago.

The son of an architect, Fresnel, as a young boy displayed little of that precocity often associated with the childhood of mathematicians, though, by his ingenious experiments on projectiles, he gained from his schoolfellows the nickname of "A Man of Genius." He showed little aptitude for literary studies, and it is said had an unretentive memory. In spite of this drawback, however, he was able at the age of sixteen and a half to pass from the Ecole Centrale of Caen into the Ecole Polytechnique, and from that famous establishment entered the Ecole des Ponts et Chaussées, the earliest of all modern technical colleges. Passing out a fully qualified Government civil engineer, he then entered upon the ordinary routine work connected with roads and bridges, and was employed in la Vendée, la Drôme and Ille et Vilaine.

Of these early years we have but little record. In 1814, however, he appears almost by chance to have had his attention turned to the science of optics and from the year 1815, when he published his first paper on diffraction, down to the time of his early death, twelve years later, his energies were mainly devoted to that branch of physics. For a short time, through his warm espousal of the Bourbon cause, he was under a cloud, but he was afterwards given a minor appointment in Paris, and ultimately because secretary to the Lighthouse Commission and an examiner to the Ecole Polytechnique.

The science of light may be said to have been founded by Lippershey and Galileo who made the first telescopes; Snell, who discovered the laws of refraction; Grimaldi, who first experimented on diffraction; Bartholinis, who called attention to the phenomena of double refraction and polarisation; Roemer, who first determined the velocity of light; and by Huygens and Newton. Their work belongs to the seventeenth century. Then followed a long period of stagnation, during which few additions were made, till the beginning of the nineteenth century witnessed the work of Young and Fresnel. Young's papers were published in the "Philosophical Transactions" for 1801–1803; Fresnel's work began twelve years later; and his memoirs are to be found in the publications of the National Institute and of other societies. To some extent Fresnel's experiments covered the same ground as Young's, but of the work of Young he was at first ignorant, and just as Young had found no supporters among the British physicists of his time, Fresnel's views had to face the opposition of some of the most prominent men of science of the day. Unlike Young, however, Fresnel proceeded to apply his discoveries to practical issues, and was thus led to the invention of the "Fresnel" lens for lighthouses. At that time mirrors were used for directing the beam of light. Built-up lenses had been described before, but they had been for burning glasses, and Fresnel was the first to suggest such apparatus for projecting a parallel beam of light, and lighthouse opticians to-day are indebted to him for the foundation of their mathematical investigations. Fresnel's work in this direction gained speedier recognition than his studies in the undulating theory, and led to his being appointed secretary to the Lighthouse Commission. The first installation of the new apparatus was that placed in the lighthouse of Corduan at the mouth of the Garonne, in 1823. The following year he devised a dioptric lens with catoptric mirrors, and it was installed in the lighthouse of Chassiron in 1827, the year of his death. Widely adopted, afterwards, the system was utilised in Holland, then in Scotland, and in 1836 was used by the Trinity House Corporation.

Though his most notable memoir of 1817 on Diffraction, the second on that subject, was awarded a prize by the Academy, Fresnel was not admitted a member of the Academy of Sciences till 1823. Two years later the Royal Society elected him a foreign member, and in 1827 awarded him the Rumford Medal. It was the sad mission of his greatest friend, Arago, to place it in his hands a few days before he died. His best monument is the magnificent system of lenses developed from his pioneering work, used in our lighthouses to-day, but his bust and memorial are to be found in the old church of his birthplace, Broglie, in Normandy.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ENGINEERS AND THE ARMY.

SIR,—I believe the public desire that the War Office officials should recognise that the engineering vocations are totally distinct from the military ones, and that a person cannot properly devote his time to both of them. Engineers should not desire to command combatant troops, nor should military officers be trained as engineers. The engineers should protest against the scheme whereby the officers of the sappers (who are named Royal Engineers) are being encouraged to study at Cambridge University for the highest degrees in engineering. The public understand the importance of fortifications and field works, &c., from the military point of view, but from the engineer's point of view there is nothing but what could be carried out by professional men, with minor qualifications to that possessed by civil engineers.

It is interesting to note that the Civil Service Commissioners and others, when they require the professional assistance of civil engineers, architects and surveyors, either in the Board of Works, Admiralty, or War Office Engineering Departments respectively, do not compel these men to be graduates in engineering. What is the reason for requiring the military men to possess a higher qualification in engineering than the civilian engineer officials? I do not understand why the engineering institutions tolerate this.

I believe that in the Engineering Department (War Office) the civil engineers, architects and surveyors are either designated surveyors, inspectors or draughtsmen, while the future Field Marshal from Woolwich Academy is designated The Engineer.

The engineers must not allow their work to fall into the hands of soldiers who are called "Royal Engineers," as if they were superior to the engineers engaged on civil contracts. I suggest that it ought to have been the Corps that was called "Royal," and not the members of it.

It is most desirable that the Secretary of State for War should consider the relationship that exists between the engineers and the people who require their services. Neither the mill owners, who require important machinery, or the mill workers "poach" on the engineers' work, nor do those who are engaged in agriculture or the fishing industries, although both are just as much connected with, interested in, and having to depend on the engineering profession as the fighting services.

Further, neither the clergy nor the medicals claim the right of designing and superintending the erection of churches or hospitals. On the other hand, the engineers, who use surveying and other mathematical instruments and who also require drawing paper, &c., never demand to control and direct the factories and mills which supply their requirements.

The engineers act in a rational manner by accepting the principle that those who require to use machines may know a little about them; but that this does not qualify them for doing the engineer's work in designing and making them, and also that those who make machines are not the best qualified for working them. Mixing up the work of the users of machinery with the work of the engineers will undoubtedly prove harmful to the engineers, as it tends to make everyone "an engineer."

Engineers must insist on the formation of a Corps of Engineers, founded on similar lines to that of the R.A.M.C., and that Woolwich Academy stops training officers as engineers. The present R.E. officers to be gradually replaced by the new class of engineer officers. The Corps might be called the Royal Corps of Engineers.

Candidates for commissions in the Corps of Engineers would be eligible up to twenty-five years of age. They would require to have served an apprenticeship of about five years under either a professional engineer or else in the drawing-office or works of an engineering firm, mechanical or otherwise, according to the engineering group to which the candidates desired to be appointed. Candidates would also require to have taken a degree in engineering at a British University. The successful candidates would have to go to Chatham for a training of six months before joining their units. Those who received commissions would serve in one group only, but all would be eligible for the posts that controlled the Corps.

It is suggested that this proposed Corps of Engineers would be the only one having officers who studied engineering and were permitted to hold engineering appointments, and it would be the only Corps which enlisted tradesmen for the carrying out of engineering work. This Corps could lend engineering tradesmen to the military Corps which might require tradesmen for repair duties in connection with the mechanical contrivances which they used, the Corps of Engineers to consist of four groups, namely:—

Civil Engineering Group.—To design and supervise the erection of all work required by the Army, such as field works, fortifications, &c., and to undertake all constructional and sanitary engineering required by the military authorities, and this group would carry out all surveying work.

Mechanical Engineering Group.—To design and supervise the manufacture of all heavy and light guns, tanks, locomotives, motors, and other mechanical engineering work required by the military authorities and to do all the repair work for units using the above as required.

Electrical Engineering Group.—To design and supervise the manufacture of all electrical contrivances required by the military authorities, such as providing for searchlights, electrical signalling, wireless, &c., and to do all the repair work required by the corps working them.

Technical Engineering Group.—Mining and the procuring of all materials and supervising their manufacture, if necessary.

July 9th. ON GUARD.

THE PROPORTIONING OF NOZZLES FOR EXPLOSION TURBINES.

SIR,—In his interesting study (THE ENGINEER, June 3rd, 1927) Dr. Wadlow develops the equation (15) for the time pressure diagram of an explosion cycle expansion.

Stodola, in his fifth edition, 1922, page 1007, gave a similar expression in the form

$$t = K\left[\left(\frac{P_0}{P_1}\right)^{\frac{\gamma-1}{2\gamma}} - 1\right]$$

where the constant

$$K = \frac{2}{\gamma - 1} \times \frac{V}{a A \sqrt{P_0 V_0}}$$

and $P_0 . V_0$ = pressure and volume in the combustion chamber at the beginning of the expansion; V = total volume of combustion chamber; P_1 = pressure in the combustion chamber after the time t.

Owing to the heat loss in the combustion chamber, the expansion is polytropic, and γ has to be chosen accordingly.

Another reason for the flat part at the beginning of the pressure time curve (Fig. 2) is given by Fig. 13 of my paper before the N.E.C.S.A., inasmuch as Holzwarth by special timing of the ignition effects a short constant pressure period.

With reference to Dr. Wadlow's statement on page 602: "Clearly, therefore, the sub-critical expansion period is the least useful, and to design a nozzle so that its maximum efficiency occurs in that range seems unreasonable," the following should not be overlooked:—

As known, convergent-parallel nozzles can very efficiently deal with much higher pressure ratios than the critical, owing to expansion taking place in the partially open end of the nozzle. In this case the moving blade inlet angle must, however, allow for the extra deflection imparted to the gas jet by the "end expansion." The jet will impinge on the blading at an angle which is greater than the nozzle angle, which can be calculated with good approximation. If, now, in the case of an explosion cycle, convergent-parallel nozzles are employed, the extra deflection of the jet will decrease with the fall in initial pressure; but at the same time the gas speed is reduced, and when drawing the velocity vector diagrams for various phases of the expansion, the interesting fact emerges that the variation of the relative direction of the jet to the runner blade is much less than for a Laval nozzle designed for the maximum pressure ratio. The latter has the further disadvantage, that for pressure ratios smaller than designed its efficiency is appreciably impaired by over-expansion shocks, particularly so for the long period of scavenging, when the "suction effect" of convergent divergent nozzles maintains critical pressure in the throat.

Rugby, July, 1927. M. KOENIG.

CENTENARY OF THE FIRST RAILWAY IN FRANCE.

SIR,—Mr. J. G. H. Warren is to be congratulated on his highly interesting article on this subject.

With regard to Verpilleux's steam tender engine, one authority gives the date of his first design as having been as early as 1842, but I am uncertain as to whether the project was then turned to practical account, in the form of an actual locomotive, or not. Could Mr. Warren enlighten me on the point?

Was not the intermediate position for outside cylinders first revived in this country in 1882 in the Webb three-cylinder compounds?

F. W. BREWER.

Stevenage, Herts., July 12th.

A PARTY of Canadian Pacific Railway engineers, headed by Mr. H. M. Dibble, has started survey work in the Lake St. John district in the vicinity of Ste. Anne de Beaupré, to select the most suitable spot where a new line from Quebec to Lake St. John could leave the St. Lawrence Valley and head north-east. Similar surveys will be carried out near Baie St. Paul and Murray Bay, the whole survey lasting nearly a year.

Railway Matters.

AT a meeting of the Railway Rates Tribunal on the 6th inst., it was announced that January 1st next would be the "appointed day" when, under the Railways Act, 1921, the new scales of charges would come into operation.

TO cope with the increasing traffic and the conversion of cable lines to electric traction, the Melbourne Tramways Board has decided to invite tenders for undercarriages for forty electric cars, with the option of increasing the number to sixty.

WHEN, in May, 1925, Mr. Gilbert S. Szlumper returned to London to be the assistant general manager of the Southern Railway, he retained the position he had held since 1920 as docks and marine manager. Mr. G. R. Newcombe was at the same time appointed deputy docks and marine manager. It is now announced that, from July 1st, he fully succeeds Mr. Szlumper.

A MESSAGE from Auburn, N.Y., states that, in a test run on the Lehigh Valley Railroad, a Macintosh Seymour General Electric Diesel locomotive hauled a special train from Auburn to Manchester and back, a distance of 90 miles, on 63 gallons of heavy fuel costing 4·30 dollars. The railway officials said that the same run would cost 32 dollars using coal for fuel. The new locomotive will go into service at once on the Lehigh Valley road.

WITH the object of expediting the railway communication between Amsterdam and Rotterdam arrangements have been proceeding for some months past for the electrification of the line connecting these two cities, and six of the steam trains are being at once replaced by electric trains. The last step in this conversion will take place at the beginning of October, when a full half-hourly service of electric trains will be introduced with a fifteen minute service during the busy times of the day.

THE Ministry of Transport railway statistics for March also give the results for the first quarter of the year. Compared with the three months ended March 31st, 1926, they indicate a decrease of 7·4 per cent. in the number of passenger journeys, of 9·0 per cent. in the receipts from passengers, and 7·2 per cent. in all passenger traffic. The tonnage of freight decreased 1·0 per cent., but receipts were higher by 3·6 per cent.—owing, no doubt, to the increase in some rates as from February 1st. Passenger train miles were 0·1 per cent. more, and freight train miles 0·6 per cent. more.

RUMOURS were very prevalent last week that the Southern Railway Company intended to carry out the desires of the former London, Brighton and South Coast Company, and electrify the whole length of the line between London and Brighton. That may, of course, be so, but it remains the fact that the overhead construction between London Bridge and Victoria and Coulsdon is to be replaced by the third rail. We would also observe that on the occasion of an inspection of some new electrical stock in March, 1925, Sir Herbert Walker, the general manager, said that the third rail was the better for suburban traffic, but it was not considered adaptable to long distances.

A CORRESPONDENT in *The Times* of June 18th raised a point which would appear to call for justification by the railway companies. The letter was headed, "A stimulus for the Railways." The point is that a week-end ticket cannot be issued to certain places until after 5 p.m. on Friday, and to other more distant places until after twelve noon. The question asked is in effect: What is gained by deferring the time of departure? It may be remarked that in the July issue of the *Great Western Railway Magazine* Sir Felix Pole, using the same heading, says that such letters do not pass unnoticed, and that a real desire exists among the railway authorities to extend to the public the greatest possible facilities in the most convenient form.

IN this column of our issue of November 26th last mention was made of the Southern Company building a new station at Epsom, which would combine the now separate stations on the Brighton and South-Western lines. It is to be at the junction of those lines, and, therefore, on the site of the "South-Western" Station and west of the "Brighton" Station. The former name actually is a misnomer, as the station is situated on what was the Epsom and Leatherhead Joint Line, and the property, therefore, of both companies. The station was —and is—however, used only by the "South-Western" trains for the simple reason that it has four lines of way with the station platforms outside. The two centre lines are continuous with the "Brighton" lines, whilst one outer line is the commencement of the "South-Western" up line and the other the end of the down. No slip points are, however, provided to allow up "Brighton" trains to go to the up platform and then proceed towards Sutton, nor for down "Brighton" trains to go to the down platform. These notes are prompted by the fact that work on the station platforms has been begun.

A POINT dealt with in Colonel Sir John Pringle's report on the collision of February 14th at Hull related to the use of "buffer" compartments, *i.e.*, the locking of the two compartments next to the engine when a van or luggage compartment does not intervene That was not done on the incoming train from Withernsea, and the explanation offered by Sir John is that whilst such used to be the practice, the adoption of steel underframes of greater strength rendered it unnecessary, and eventually the construction of corridor vehicles made it impossible to carry the practice into effect. No regulations, he adds, have been made on the subject, either by the Board of Trade or the Ministry of Transport, chiefly because the position in a train at which telescoping may occur is uncertain, and, of late years, it has been considered that by shortening the length of the couplings and strengthening the underframes and ends of passenger stock, better security could be afforded against telescoping. On the former point it may be remarked that in the Withernsea train there was telescoping in all the first five vehicles. We would add that not only have buffer compartments not been the subject of a requirement, but they are not ordered in the railway companies' rule book. They are mentioned only in their appendices, which indicates that the regulation is local and not standard.

Notes and Memoranda.

IT appears, from the *Bulletin* of the Institution of Engineers, Australia, that the new 12,500-kilowatt Parsons turbo-alternator installed at Perth, W.A., has to work with condensing water which may range in temperature at the inlet from 85 deg. to 90 deg. Fah. A vacuum of 28in. is, nevertheless, attained. There are two condensers, having a total cooling surface of 25,000 square feet.

AN article on "The Transformations in Hardened Steel due to Annealing," by H. Hanemann and L. Traeger, in *Stahl u. Eisen*, points out that annealing temperatures of only 100 deg. Cent. had a decided influence on hardened steel; when annealed for duration of fourteen hours, the hardness of a carbon steel is completely changed by the heat of boiling water. For tool steel, an annealing temperature of 200 deg. to 300 deg. Cent. is customary. If it is desired to make a hardened steel volumetrically constant for temperatures above 280 deg. Cent., an annealing temperature of 400 deg. Cent. is necessary.

RADIOPHONE communication between the driver in the locomotive cab and a brakeman in the "caboose" of a freight train a mile and a quarter long has, it is reported from Schenectady, been demonstrated satisfactorily by the American General Electric Company. Brakeman and driver, it is stated, talked to each other as easily as two persons would talk over an ordinary telephone. The locomotive and caboose had identical equipment, consisting of two antennæ, one for transmitting and the other for receiving, a radio transmitter operating on a short wave so as not to interfere with regular broadcasting, and a receiving set.

THE substitution of underground cables for overhead wires in Sweden's telephone system continues. The cable laid some years ago between Stockholm and Gothenburg has been a complete success, and the frequent interruptions which occurred on the line, especially in winter, have now been practically eliminated. The cost of the cables is well counterbalanced by the disappearance of the cost of repairs to overhead lines. Another cable, 185 kiloms. long, is now being laid between Stockholm and Gaefle, and the cable to Norrkoeping will probably soon be extended to Malmoe, thus rendering the chief trunk lines independent of bad weather.

IN a recent publication issued by the Forest Research Institute at Dehra Dun, India, in connection with the durability of railway sleepers, it is stated that according to Mr. Pearson the expectation of life for *chir*, *kail*, *in* and *kanyin* is about ten or eleven years, and that of *sain* about twelve. He says his estimate is conservative. Time has shown that it was indeed so as these sleepers have now been found by actual experiment to have a life of nearer fourteen and sixteen years respectively. But even now it is more than likely that that figure is a conservative one, and it will probably be found that the life of all the timbers tried is again greater than is at present estimated.

AN article by Dr. E. Goulding in the *Bulletin* of the Imperial Institute directs attention to pineapple and oil palm fibres as being of excellent qualities, but he says that they cannot become available for export until they can be produced on a commercial scale by a much more rapid process than native hand labour. They are all fibres of excellent character, and would undoubtedly meet with a ready demand if they were marketed in large quantities at reasonable prices. There is therefore an opportunity for some inventive genius to devise a suitable process or a satisfactory machine for their extraction. The problem is doubtless a difficult one, but its solution would be amply repaid.

A RETURN recently issued by the Swiss Union of Electricity Consumers shows that the association now comprises 109 firms connected with the textile industry, 51 with the food supply trade, 25 with the chemical industry, 22 with the paper, leather and timber trades, and 144 with the engineering and metallurgical industries. In addition, there are 120 other miscellaneous members, as well as eight electric railway undertakings. The whole of the members are responsible for an annual consumption of purchased electric power of 650 million kWh, in addition to a private output of 100 million kWh. It is estimated that the consumption of electricity in Switzerland now amounts to 980 kWh per year per head of the population.

IT is reported from Cape Town that at a race meeting held on July 9th a new invention—an automatic timekeeper—was tried with complete success. It is worked by a ray from a lamp in the judge's box, one-fifth of an inch in diameter, which is focussed across the course on to a selenium cell fixed in the winning post. Anything crossing the line of the ray prevents the latter reaching the cell, and the exact moment that the stoppage occurs is registered. The device is an invention of a Cape Town wireless expert, Mr. Streeter. The clock is a large affair, 9ft. high, but the actual timekeeper is a pocket chronometer attached to a miniature wireless transmitter. The start of the race, &c., is controlled by a two-valve amplifier.

IN the manufacture of steel, no satisfactory substitute for manganese is known, declares the United States Bureau of Mines. In Germany during the years 1917 and 1918 the shortage of manganese necessitated trial of many substitutes, such as aluminium in the form of silicon-aluminium alloys. Aluminium has a greater affinity for oxygen than manganese, but the oxidisation of aluminium produces alumina which is relatively infusible and often remains in the steel as slag inclusions. Aluminium cannot eliminate sulphur or change the condition of sulphur as manganese can. A slight excess of aluminium tends to produce large pipes in the ingots. Silicon in the form of ferro-silicon probably has a greater affinity for oxygen than manganese, but its use is attended by the following disadvantages:—In slight excess it causes large pipes to form in ingots; the products of oxidation remain in the steel; it has no effect upon sulphur and no effect on the molecular arrangement of the metal. Ferrotitanium is the most powerful deoxidiser known. Titanium does not alloy freely with iron and imparts to steel qualities that are not acceptable to the trade. Calcium, sodium, vanadium and boron alloys have been tried as deoxidisers, but homogeneous steel was not produced when they were used.

Miscellanea.

SOME deposits of nickel-bearing rocks of promising value have been discovered in the Society Islands.

A RICH vein of gold-bearing quartz is said to have been discovered near New Glasgow, Nova Scotia.

IT is proposed to build a new bridge over the Palmiet River, at Elgin, South Africa, at a cost of from £8000 to £12,000.

A HYDRO-ELECTRIC plant of 65,000 horse-power, working with a head of 26ft., is to be put up on the Rivière des Prairies, Montreal. Two-thirds of the plant is to be completed by the end of 1929.

IT is being urged that the Fairfield Railway Bridge over the river Yarra, Melbourne, which was built at a cost of £90,000 and has not been used for forty years past, should be employed for vehicular traffic.

THE hulk of the brig Nancy, sunk near the mouth of the Nottawasaga River, Canada, will be raised by Government workers this summer. When raised, this relic of the war of 1812 will be placed on a suitable site somewhere in Simcoe county.

THE cableship Restorer left Victoria, British Columbia, on June 9th with 70 miles of cable to lay the last two links in the second All-Red cable connecting Canada with Australia and New Zealand. The Canadian Pacific Railway is completing the work, and will link up the cable with a newly-completed copper wire line from Vancouver to Halifax.

IT is proposed, says the *Industrial Australian*, to form a company for the manufacture of artificial silk in Tasmania with a capital of £350,000 in the form of 200,000 preference shares of £1 each and 750,000 ordinary shares of 4s. each. In consideration of the guarantee of interest on certain of the debentures, the treasurer, on behalf of the State, is to receive 234,375 fully paid-up 4s. ordinary shares.

IT is reported by the National Federation of Iron and Steel Manufacturers that the number of furnaces in blast at the end of June was 175, a net decrease of nine since the beginning of the month. The production of pig iron in June amounted to 650,500 tons, compared with 720,100 tons in May and 680,000 tons in April. The production includes 219,300 tons of hematite, 216,300 tons of basic, 167,400 tons of foundry and 23,100 tons of forge pig iron. The production of steel ingots and castings amounted to 747,300 tons in June, compared with 884,600 tons in May and 850,100 tons in April.

ACCORDING to the *Far Eastern Review*, Japanese electric power companies are mustering their forces with the object of opposing the Government project to build a giant power plant on the Shinano River, developing 154,000 kilowatts. Private power interests condemn the project from two aspects—First, it is decidedly wasteful; secondly, it will place an unfair burden upon private enterprise. According to Government estimates, the cost of each kilowatt unit in the Shinano plant will be 649 yen. The Sakuma River plant of the Toho Electric Power Company, which has a capacity of 100,000 kW, cost but 450 yen per kilowatt. The two Oi River plants of the Toyko Electric Power Company, with a combined capacity of 187,300 kW, cost but 400 yen per kilowatt. Moreover, the Government already has spent 5,000,000 yen in investigations which have covered six years, and, if the cost of the necessary reserve plant and the high-tension towers connecting the stations with the central railway lines is added, the cost per kilowatt may very easily touch 1000 yen—an unprecedented figure.

IN a message to the Department of Overseas Trade the British Consul-General at Cologne states that, according to a recent issue of the *Deutsche Bergwerks Zeitung*, the leaders of the Provincial and District Associations and the other interested parties met recently with a view to forming what is known as the Central German Community of Interests in Distant Gas Supply—Interessengemeinschaft der Gasfernversorgung. It is intended to tap the long-distance gas pipe line which goes from the Ruhr district, *viâ* Hanover, to Berlin, which is 480 kiloms. in length and has cost 40 million R.M. This pipe line, as Director Seippel, of the A.G. für Kohleverwertung, states, will supply gas to the Berlin Gasverwertungsgesellschaft at a price of 3·9 pfg. per cubic metre. The Central German Distant Gas Supply Community of Interests would, if it calls for 38 million cubic metres of gas, obtain this gas at 3·8 pfg. per cubic metre delivered at Cassel. It was decided, on principle, to join the "Rheinisch-Westfälische Gasgesellschaft"—the proposed mixed industrial company—at Essen, which, according to the statement of Director Seippel, has declared its readiness to lay this piping to Cassel at its own risk and to carry out the connection, so that the central German district will be able to be supplied with pit gas at high pressure at a maximum price of 3·8 pfg.

TO provide electric energy for the Marches, Umbria, Abruzzi, Molise and other industrial parts of Central Italy, a hydro-electric station has been recently completed at Mozanno—Ascoli Piceno. The works, which were begun in 1925 with the utilisation of the waters of the river Castellano, comprise a dam near Castel Trosino, forming a reservoir capable of storing 12,000 cubic metres, and diverting the stream by means of a canal carrying 7 cubic metres per second. The canal has a length of 1800 m., of which 1400 m. are in tunnel. The power pipes, 300 m. long, with an initial diameter of 1700 mm. and a final diameter of 1400 mm., are made of closely riveted steel plates. Before being placed in position, they were tested up to a pressure of 18 atmospheres. There are three turbines designed for the use of a fall of 119 m. Each is provided with a regulator, in addition to a discharge synchroniser, to control, when necessary, the pressure in the pipes at 13·5 atmospheres. The electric generators consist of three-phase alternators with their respective exciters, allowing the distribution of three-phase energy at the industrial frequency of 50 periods and a tension of 5000 volts. Each turbine and alternator group has a capacity of 2200 kW. In the power-house there are three transformers of 3200 and two of 2000 kW. Two high-tension lines, one of 30,000 and the other of 65,000 volts, will distribute the current produced. All the machinery and plant were constructed in Italy.

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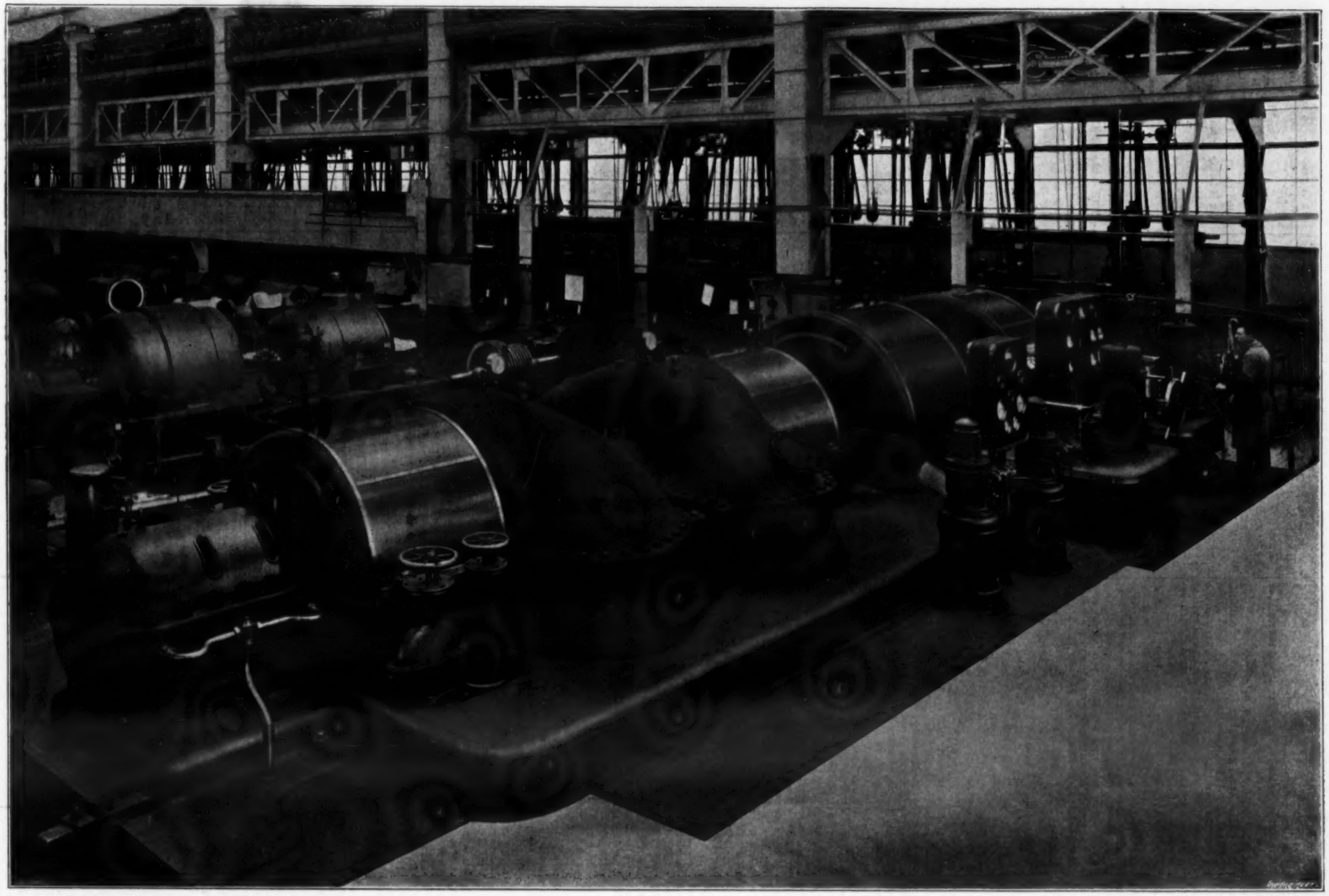
MESSRS. STORK BROTHERS, HENGELO, HOLLAND, ENGINEERS

(*For description see page 58*)



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THE ENGINEER.

JULY 15, 1927.

Electrical Converting Plant.

A SUBJECT that often gave rise to discussion in bygone days was the relative merits of different forms of electrical converting plant. While it was generally recognised that rotary converters were appreciably more efficient than motor generators and slightly more so than motor converters, they did not work satisfactorily on 50-cycle supplies. Much of the 25-cycle generating plant now in operation is the outcome of the inability of those early machines to run well at the higher frequency, and the task of interconnecting power stations has been made more difficult than it would have been if reliable 50-cycle rotaries had been available at an earlier date. To-day alternating current at the proposed standard number of cycles can be turned into direct current by rotary converters, motor converters, motor generators and rectifiers. For 3000-volt railway electrification schemes and for other work of a special nature the motor generator still holds its own, although, largely on the score of better efficiency, one or other of the alternative converters is generally used for ordinary purposes. While to a large extent improvements in rotary converters have deprived motor converters of some of the principal advantages originally claimed for them, the demand for these machines is by no means negligible. As the two revolving parts are electrically connected as well as mechanically connected, motor converters have a better efficiency than motor generators, and some engineers still prefer them to rotary converters when the supply is a 50-cycle one. A feature common to both the motor generator and motor converter is that if the supply pressure does not exceed that which can be applied to stator windings, transformers are unnecessary. On a motor generator any desired voltage range can be obtained without the use of additional equipment, such as alternating-current boosters or induction regulators, whilst by using two series connected generators large traction motor generators can be built for a pressure of 3000 volts. With a synchronous driving motor these machines will also correct the power factor without affecting the direct-current voltage. All three machines are reversible; in other words, they will supply alternating current when fed with direct current, but as lagging currents in the armature of a rotary converter have a demagnetising effect on the field it is necessary to take precautions to prevent racing. The three machines may be discussed from various other angles, such as the relative amount of space required and relative initial cost. As, however, rotary converters are most commonly used, it is clear that, generally speaking, they are the most advantageous, although a different type of machine sometimes proves better. While, for example, the design of a 50-cycle rotary for a pressure of 1500 volts is not altogether an easy task, and some manufacturers advocate connecting two 750-volt machines in series, 1500-volt 50-cycle motor converters work quite well. For voltages such as those used on most British electric traction systems, the modern rotary converter easily holds its own. As long as machines are employed for converting purposes it is very doubtful if anything more simple than a rotary will ever be devised. A field magnet system, an armature with tappings from the windings connected to slip rings, and transformers for reducing the supply pressure, constitute practically the entire equipment. With a proper amount of reactance on the alternating-current side and a compounded field, all the voltage regulation necessary for traction work can be secured. The influence which these machines have on the power factor of the system is also good.

Only within comparatively recent years has this converter been threatened with a rival in the form of the mercury vapour rectifier. For large outputs the metal-cased rectifier must be employed, but so far as this country is concerned this type of apparatus has not made much headway. Possibly this may be partly attributable to the fact that the metal-cased rectifier is not a British production; it may also be due to the circumstance that most of our traction schemes are low-pressure schemes, on which the rectifier does not show up to the best advantage and to certain troubles that have been experienced. On continental direct-current systems, however, these metal-cased mercury vapour rectifiers are becoming common; they are also being tried in the United States, where experiments were made in this connection as far back as 1908. As we reported about that time, attempts were made to use these rectifiers on single-phase trains with a view to employing direct-current motors, whilst in 1915 an experimental 5000-volt rectifier sub-station was put into operation. But although much valuable experience was derived from these experiments and various rectifier patents were granted to the Westinghouse Company, it was apparently decided that at the time the field for the rectifier was not sufficiently attractive to warrant further expenditure. Within recent times work in this connection has been renewed, and a combination of the early practical experience of the Westinghouse Company and that of European concerns, notably that of the Siemens-Schuckert Company, has been turned to practical account. In the June issue of the *Journal* of the American Institute of Electrical Engineers the early experiments made by the Westinghouse Company are described by Mr. E. B. Shand, whilst in the previous issue of the *Journal* Mr. C. A. Butcher deals with the application of the mercury arc power rectifier. As the rectifying action is brought about simply by the unidirectional conductivity of the mercury arc in a vacuum, it might well be supposed that the apparatus is cheap, but as those who have gone into the matter are well aware, this is very far from true. For automatic operation, however, the equipment for the rectifier should be a good deal cheaper than that needed for rotaries. The main conclusion arrived at by Mr. Butcher is, we believe, a pretty general one, namely, that at present the most promising field for the mercury vapour rectifier is for the electrification of railways at the higher voltages. For 600-volt traction systems rectifiers and rotaries are considered to be about equally good, whilst for mining and industrial railway work at 250 volts the retcifier is believed to show no economy whatever. Curves in the paper indicate that for voltages below 500 the efficiency of a rectifier installation is less than that of a synchronous converter installation, except at light loads, whilst at higher pressures—1500 volts, for example—the rectifier shows a decided advantage over the synchronous converter. The ability of these rectifiers to maintain a good efficiency at low loads is one of their outstanding advantages, which is brought about by the fact that the drop in the arc is practically constant at all loads. The arc losses are the product of the current and the arc drop, but to obtain the true commercial effi-

ciency the losses in the transformer and auxiliaries must be taken into account. As the iron losses in the transformer are to all intents and purposes constant at all loads, the main losses down to about quarter load are constant and the efficiency remains at a high value, which up to a point increases with the supply voltage. A rectifier will not, of course, permit of regeneration, nor can it improve the power factor like synchronous machinery. As it is a static piece of apparatus, however, which works without noise or vibration, it can be installed in places where machinery would be prohibited. Besides the metal-cased mercury vapour rectifier there is the glass bulb rectifier, which is a British product. Within recent times sub-stations equipped with these rectifiers have been established, but the permissible output of the individual bulbs is small as compared with that which can be obtained from a metal-cased rectifier. A good case has been made at Birmingham for glass bulb rectifier sub-stations which supply direct current to outlying areas. The sole reason for building these sub-stations was apparently to avoid giving a 25-cycle supply for domestic purposes. For lighting, direct current or 50-cycle alternating current is undoubtedly better than 25-cycle current, which, however, is often used. Not many miles from the city of Birmingham, in fact, several thousands of houses are lighted with electricity at 25 cycles per second. The entire supply of current from the Niagara Falls stations, amounting to a total plant capacity of 1,000,000 kW, is generated, transmitted and distributed at 25 cycles per second.

With a view to economy the present tendency is, of course, to avoid conversion and to supply alternating current, for it is now generally recognised that direct current costs more to produce than alternating current. No one would dream of installing converting plant for the supply of electricity to farms and scattered areas in which current must be sold at the lowest possible rates. For the electrification of the whole country high-pressure alternating-current lines must run to all places where current is likely to be required, and the pressure must be reduced by static transformers, which are very much cheaper than any form of converter or rectifier. On a large part of the Continent, and to some extent in America, it has also been decided that high-tension alternating current must be used for the electrification of long-distance railways, whilst in this country it is considered better to indulge in conversion and to erect innumerable sub-stations for that purpose. In his address on "The Present and Future Development of Electricity," delivered before the Engineering Section of the British Association last year, Sir John Snell drew attention to the fact that the cost of the converter sub-station is some seven to eight times greater than that of static transformer sub-stations. The actual cost, for example, in Glasgow is £15·96 per kilowat' installed for the former and only £1·822 for the latter, the ratio of the costs in this case being 8·76 : 1, whilst if the operating costs, including capital charges, be compared, the figures are 0·192d. and 0·0334d. per unit respectively. In a large English city where alternating-current distribution has been adopted, except for the supply of the local tramway system, the capital outlay on distribution, including high-tension feeders and sub-stations, low-tension mains, services and meters, has actually been reduced to £13·48 per 1000 units sold, whilst the future cost is estimated at £11·25. There is little doubt, in our opinion, that sooner or later the comparatively few consumers who must have direct current will have to obtain it by installing a converter or rectifier on their own premises, as some large consumers have already done. For conversion under these conditions the rectifier may find a wide field of application, because it is simple, and apart from cost, it is a fairly near approach to a static transformer. Some day it may be possible to rectify on a very large scale and with a very high efficiency and to convert the direct current back again to alternating current with equal facility. It would then be possible to interconnect power stations with direct-current high-pressure lines when to a very large extent the need for a standard frequency would no longer prevail.

Tube Arrangements of Condensers.

OF the major pieces of apparatus in a power plant there is none which works under such constancy of conditions as the condenser. As between one station and another, steam pressures and superheats may vary by hundreds per cent., voltages and frequencies may have almost as wide a range, varieties of practice as regards boiler firing, feed heating, air heating, &c., are almost infinite, yet to all of these the condenser designer is practically indifferent. Whatever the nature of the plant in the boiler-house or engine-room, his problem is the same within very small limits. With a temperature of circulating water which only varies by a comparatively few degrees for the average power station in this country, he has to produce a vacuum which is almost equally standardised. The fact that the vacuum required is the highest that can be obtained for the particular circulating water conditions, consistently with a reasonable expenditure of pumping power, may make his task more difficult, but it does not alter its essential sameness. It would therefore be reasonable to expect a great similarity between condensers. Their importance is quite sufficient to prevent any indifference as to their performance, and one would have thought that the concentration of many minds on a particular problem would have resulted in an agreement as to what was the best solution. Yet what do we find in practice? A consensus of opinion, certainly, that a condenser should consist of a shell containing a lot of brass tubes through which the circulating water is pumped, but agreement really ends at this point. Even cylindricality of the shell is not universal by any means, various other forms being advocated on theoretical or practical grounds. The condenser is also sometimes built with its axis vertical, usually when the circulating water is extremely dirty, but this again is a variant from the typical form.

Taking, then, the horizontal cylinder as representing ordinary condenser design, we come upon a divergence of opinion as to what the interior should be like, which is really extraordinary, considering the general similarity of the duties to be fulfilled. The tubes may be anything from ·625in. to 1in. diameter, even for condensers of the same length, giving for equal tube volumes, a difference of 60 per cent. in the cooling surfaces. The water may flow straight through all the tubes in parallel, or these may be divided into two, three or four groups, giving a corresponding number of "passes" before the water is finally discharged. Convenience of location of inlet and outlet pipes may influence the choice between an odd or an even number of passes, but the divergency of views of designers is shown by the fact that some will adhere to the single-flow and others to the multi-pass principle for identical duties, quite apart from the convenience or otherwise of the resulting pipe lay-out. It is, however, when we study the arrangements of the tubes themselves that the most extraordinary variety of ideas becomes apparent. At one end of the scale we have condensers with neither steam lanes nor drain plates, the tubes being perhaps more widely spaced where the steam enters, but with no other departure from absolute simplicity. Such a design would by some be considered obsolete to-day, but many excellent condensers were constructed on such lines. Then came the idea of steam lanes, short and straight at first, as if tentatively leading the steam into the interior of the tube system. Then drain plates were added, partly with the view of directing the steam among the tubes, and partly with the object of catching condensed water and preventing it interfering with the action of the tubes beneath. Once complications had started, imagination ran riot. Steam lanes and drain plates were multiplied, placed in all sorts of positions and all sorts of angles, until now it is difficult to guess what, in some condensers, the designer really hopes the steam to do. If anyone thinks this picture exaggerated, he has only to compare the tube lay-outs of half a dozen large condensers constructed by different firms. Sometimes, of course, there has been an obvious idea in the minds of the designer which has dominated his lay-out. The provision of a broad passage down through the centre of the tube system, which will give direct access of the steam to the condensate, and thus allow the latter to be withdrawn at the highest possible temperature is a case in point. Then, again, causing the steam to enter the tube system round the whole circumference of the latter, and withdrawing the air from the centre of the condenser is also an intelligible method of design, based on the idea of obtaining a hot condensate, and at the same time a very short steam path. Another design, resting on a rational foundation, consists of a fan-shaped arrangement of the tube rows, radiating from a point near the bottom of the condenser, so that the steam passages between them become progressively smaller as the volume of the steam is diminished. Other tube arrangements, each tending to the attainment of some definite object, exist; but the mere fact that so many different designs can hold their own in the market at the same time would seem to indicate that what advantages there may be in each are attained largely at the expense of some compensating disadvantages. This can be freely admitted without any suggestion that some tube arrangements are not inherently better than others. A few years ago much prominence was given to the fact that the alteration of tube arrangement in some large condensers in a French power station in accordance with a new principle had increased the coefficient of heat transmission from 274 B.Th.U. to 433 B.Th.U. per square foot per degree Fahrenheit. The latter figure is good, but it is attained and surpassed in plenty of condensers without the special tube arrangement. As long ago as 1912 figures were given in a paper by Lord Weir showing a coefficient as high as 975 B.Th.U. for a 240,000 lb. condenser of the straightforward Uniflux type. This, however, is exceptional, but numerous condenser tests have given coefficients of 700 B.Th.U. and over.

Efficient condenser design would seem to depend more on ensuring a good distribution of steam longitudinally through the condenser, and making adequate provision for cooling the air, than on any extraordinary arrangements of the tubes. British makers have led the world in condenser practice, largely no doubt on account of their unequalled experience in marine work. When such experience has been turned to the problem of large high-vacuum condensers for power stations, the result has been, in general, a simplicity of design and a standard of performance both in advance of most of the continental products. With an ample area for the longitudinal distribution of the steam, before its entrance to the tube system, and a short and direct flow, of diminishing cross-section, through the latter, performances quite as good as those obtainable with a multitude of steam lanes and drainage plates, or any fancy arrangement of tubes, can be recorded. It would, we believe, be greatly to the advantage of the best British manufacturers, and certainly to the interest of purchasers, if some independent body could be commissioned to report on the actual performaces of a number of different types of condenser, much as has been done recently in the case of marine oil engines. If British designs are the most efficient, as we are confident they are, the fact might well be demonstrated. If, on the other hand, they have lost the lead, this also, it would be well to know. In the latter event, the remedy is not for our manufacturers to make foreign designs under licence, but rather to develop something better for themselves. The payment of a few thousands of pounds in licence fees is nothing; the real harm in working to foreign designs is an admission of inventive bankruptcy which reacts on British trade generally. Quite recently we had direct evidence of the truth of this, a customer having been assured that British condenser practice was behind that of some other countries, because "the best British manufacturers were working under foreign licences." Ludicrous as the assertion was, the fact that a number of firms were building condenser auxiliaries or condensers of foreign design could not be denied, and it was nobody's business to point out that there were plenty of others who led in design rather than followed. Many and many an order, especially from the outlying parts of the world, is given to a British manufacturer on the grounds of prestige alone, and nothing can be more harmful to this prestige than the assertion by a foreign competitor that British makers are reduced to manufacturing something under licence which has been invented and developed elsewhere. It is a matter of importance not only to our condensing plant manufacturers, but to all who are concerned with the prosperity of British engineering industry, that the lead in design of which the founders of the industry were capable shall not be thrown away by lack of enterprise. To follow is necessarily to be behind, a fact which our foreign rivals are quite clever enough to exploit to their own advantage.

Institute of British Foundrymen.

No. I.

SHEFFIELD CONVENTION.

THE Institute of British Foundrymen held its annual Convention this year at Sheffield, from Tuesday to Friday, July 5th to 8th, under the presidency of Mr. J. T. Goodwin, M.B.E., M.I. Mech. E., of the Sheepbridge Coal and Iron Company. There were present over 300 members and guests, including ladies, and an excellent programme was arranged for their instruction and enjoyment. There were three

sessions devoted to the reading and discussion of papers, and arrangements were made also to visit a number of works, including those of Edgar Allen and Co., Ltd., Cammell Laird and Co., Ltd., Newton, Chambers and Co., Ltd., Vickers Ltd., Darwin's, Ltd. (safety razor blade manufacturers), Davy Brothers, Ltd., Samuel Osborn and Co., Ltd., and the Brown-Firth Research Laboratories.

On Tuesday evening the members and guests attended a reception and dance at the Cutlers' Hall, at the invitation of the Master and Mistress Cutler (Mr. and Mrs. David Flather). On Wednesday morning, July 6th, the members assembled in the Mappin Hall at the Department of Applied Science, Sheffield University, St. George's-square, and a hearty welcome was extended to them on behalf of the Corporation and the University by the Lord Mayor (Alderman J. G. Graves) and the Vice-Chancellor of the University (Sir Henry Hadow) respectively.

After the speeches of welcome the Lord Mayor presented to Professor T. Turner the Oliver Stubbs Gold Medal, which is presented annually to those distinguished in ironfounding and who have rendered good service to the Institute. A hall clock was then presented to Mr. John Shaw, of Sheffield, as a mark of esteem from the members of the Sheffield branch and other members of the Institute, in view of his pending retirement, and in recognition of his eminent services to the Institute.

The Annual Report.

The annual report of the General Council for the year 1926–27 showed that the membership on April 30th last was 1636, as compared with 1574 in the preceding year. During the year, the report stated, the Committee of the British Engineering Standards Association dealing with the standardisation of test bars completed the drafting of a tentative specification for grey cast iron, which followed to a great extent the lines laid down in the original specification issued by the members of the Institute's Test Bar Committee. The whole of the clauses in the B.E.S.A. tentative specification were accepted by the various bodies represented, with the exception of a clause introduced at the final meeting. This clause, which related to a guaranteed time limit before the manufacturers' responsibility ceased, was opposed by the representatives of the Institute, and the settlement awaited a further meeting.

With regard to international tests for cast iron, Mr. Shaw, a representative of the Institute, attended an informal international meeting at Detroit, at which a preliminary discussion took place on the tests in operation in various countries. Mr. Shaw had promised to carry out certain tests by a modified "Freemont" method, but had not yet been able to commence the tests, as he had not yet received the drawings of the necessary apparatus.

Reference was also made in the report to the fact that the very close relations between the Institute and the British Cast Iron Research Association continued. In July, 1926, the Association had started on its sixth year, with the assurance of very generous grants in aid from H.M. Government during the second five-year period of its existence. This support was conditional upon the Association receiving an income of £4000 per annum, and the support of all ironfounders was earnestly requested, not only to ensure this sum, but to increase it to at least £6000 per annum, the limit up to which subscriptions would be doubled by means of the grant. The main development in the last year had been the acquisition of headquarters, offices and laboratories in one building at 24, St. Paul's-square, Birmingham, and this combination of offices and laboratories, hitherto separately conducted, had resulted in many advantages and economies in working.

Presidential Address.

Mr. J. T. Goodwin, the new President, said in his address that the Association had actually started as the disastrous slump of 1921 was setting in. From the effects of that slump the iron and steel industry had not yet recovered, for, while consideration of pig iron and steel output statistics would show that the situation was now as favourable as at any time since then, there was still an inadequate margin between manufacturing costs and selling prices. Nevertheless, the formation of the Research Association had come none too soon. A new organisation in this country was necessary, not only to ensure that results of work published abroad could be made available here, but also to initiate research work on British irons, melted in cupolas of British type with the fuel and refractory materials British foundrymen had daily to use. The extent of the Government's appreciation of the work done was shown by the generous financial support it had promised during the period 1926–31. That support was conditional on a better response from the industry than was at present being made. He estimated that the industry could expend, with advantage to itself, and at an annual cost per firm which amounted to a little more than an insurance premium, a sum of £25,000 per annum. At present one-third of that was available and half of it came from the industry. Now that the organisation was built up, for every £1 subscribed, £2 could be expended directly on work of assistance to members.

The reading and discussion of papers was then proceeded with.

Cupola Practice.

Following the presidential address, two papers were read and discussed together, viz., one presented on behalf of the American Foundrymen's Association, entitled "The Properties of Coke affecting the Cupola Melting of Steel," by J. T. MacKenzie, of the American Cast Iron Pipe Company, Birmingham, Alabama, and "The Importance of Air Control in Efficient Cupola Practice," by P. H. Wilson, foundry general manager of the Stanton Ironworks Company, Ltd.

In the paper by Mr. MacKenzie, cordial greetings and best wishes were extended by the American Foundrymen's Association to the British Institute, and the hope was expressed that the two bodies would be drawn closer and closer together by the annual exchanges of thought in such papers, this being regarded as the foundation of international goodwill. The paper itself was concerned chiefly with the total carbon absorbed by steel scrap when melted with various cokes of an unusual collection, not complete, but well representative and containing the extremes likely to be met with. The cokes, of course, were all of American origin, and it is deduced from the tables of results that the structure of the coke is of fundamental importance, and may counteract to a considerable extent the effect of the composition. The cupola used was a No. 0 Whiting with a 27in. shell lined to 18in. with clay brick, with two tuyeres 17in. above the mantel plate and 70in. below the charging door. The lining was straight from mantel to charging door. The tuyeres measured 9in. by 3in. at the lining, and the blast, supplied by a fan, was fairly constant at 4 oz. per square inch. The cupola was heated in the usual way and the wood allowed to burn away by natural draught, coke being put on to make the bed at 30in. above the tuyeres when this was accomplished. The wind was then put on for five minutes to heat the tap hole and basin, after which the bed was built to 40in. with fresh coke, the breast stopped in, the charges quickly put in and the blast put on as soon as the stack was filled—about five minutes. The first tap was made in twenty-five minutes, when usually 25 lb. to 75 lb. of iron were obtained, after which melting proceeded at the rate of approximately 1000 lb. per hour. A shank ladle of 200 lb. capacity was used for handling the molten iron, which was poured into pigs on the first two or three taps, and then into well blacked and dried test moulds, giving the 2in. by 1in. by 28in. bars cast vertically. Charges were 100 lb. with sufficient 50 per cent. ferro-silicon and 80 per cent. ferro-manganese to give the required composition.

The principles underlying success are given—(1) temperature; (2) time of contact with carbon; (3) atmosphere of combustion. Looking at the problem solely from the standpoint of the coke, the case was stated as follows:—That the temperature depends on the purity, reactivity and size of the coke in the melting zone and below; that the time of contact depends on the purity and size of the coke, for the higher the ash the greater will be the tendency to cover up the carbon by slag and prevent contact with the metal; and that the atmosphere of combustion depends on the purity, reactivity and size of the coke. Since the reactivity depends on the purity and physical structure, and since the effective size of the coke depends on the structure, it might be assumed that the extent of carburisation depends on the purity and structure of the coke. Unfortunately, says the author, the testing of coke has not reached the plane of true science, and although it can be taken for granted that the reactivity is a function of structure, no one is yet sure of a test that will indicate the right structure for maximum reactivity. It would appear that for carburisation, coke should not be either extremely dense or extremely porous; that it should be neither too hard nor too soft, and that it should be neither very heavy nor very light. A hard, dense coke will tend to allow oxygen to persist a long distance above the tuyeres, and the molten metal will flow over a comparatively small surface of coke on its way through the melting zone, where most of the carburisation takes place.

The tests detailed in the paper are to be extended with the view ultimately of devising a test for coke, whereby the equilibrium point for a particular coke can be pre-determined with a fair accuracy for any given set of conditions.

In Mr. Wilson's paper it is stated that although the composition of molten metal is more or less determined by the analysis of the materials charged into the cupola, inefficient working has a serious effect on certain elements in the iron during the melting operation. Silicon and manganese may be considerably reduced due to excessive oxidation. Further, the absorption of detrimental gases affects the temperature and fluidity of the molten metal, as well as its physical and mechanical properties. The efficient working of any cupola depends primarily on the quantity of air supplied at a suitable pressure, according to its capacity. The melting capacity of a cupola is determined by its effective diameter at the melting zone. In practice 1 lb. of good coke has been burnt per hour per square inch of cross-sectional area at this point. This is equivalent to from 10 lb. to 12·5 lb. of iron melted per square inch of area per hour. Therefore a cupola with a diameter of, say, 4ft. 6in., is capable of melting economically approximately 10 to 12·5 tons per hour. Figures given for the melting capacity of a cupola relative to its cross-sectional area at the melting zone, vary to the extent of 25 per cent. This variation is dependent upon the percentage of coke consumption to iron melted, and also the percentage of carbon in the coke. The paper gives formulæ for calculating the melting rate per hour for any size of cupola, given the coke consumption per ton of iron and the diameter, and also for the amount of air required. It is pointed out that the number and shape of tuyeres has long been a debatable point, but Mr. Wilson lays it down that the main requirement is that they should be sufficiently large to admit the correct quantity of air at a pressure not higher than that necessary for the air to penetrate the coke bed and distribute it uniformly at the melting zone.

Having dealt briefly with some of the conditions which affect the working of a cupola, the author outlined some matters which he regards as of vital importance in connection with the control of the air supply. He lays it down that the maximum thermal efficiency is obtained when the carbon is burned to CO_2 in one stage. If the carbon is burned to CO and is further oxidised to CO_2, the thermal efficiency is reduced by approximately 38 per cent. To obtain maximum efficiency, the percentage of CO formed must be kept at a minimum. When the air is forced into the layer of incandescent coke above the tuyeres, combustion takes place. If the coke layer is uniform in size, shape and disposition, and the air is supplied at the correct velocity and volume, then combustion will be uniform across the coke layer. If these conditions in the cupola are not sufficiently uniform and the air is admitted at too low a pressure, it will not penetrate sufficiently to the centre of the fuel, consequently the combustion will not take place evenly across the section. It tends to be greatest near the lining of the cupola and the combustion takes the form of an inverted cone. On the other hand, if the blast-pressure is high, there is a tendency for the combustion to be greater at the centre and for the cone to be reversed.

The results of a series of experiments to prove these points are given in the paper, and it is deduced from the figures obtained that under correct working conditions the method of taking the samples of gas for analysis from the side of the cupola gives an approximate indication of the average composition of the gases across the zone. Further tests were made to find the effect on the resulting gases at different heights using varying coke ratios, the volume and pressure of air remaining constant. As to the correct tuyere ratios, the author says it is a mistaken idea that large tuyeres are difficult to keep clean and free from slag. That is not the case where the correct volume of air is used at a suitable pressure. All the experiments, of which results were given in the paper, were carried out on a 4ft. 6in. cupola, and it is stated that experience has proved that the scientific control of the air blast at the cupola does pay from the point of view of (1) economy in fuel, (2) reduction in waster castings, and (3) saving in iron losses. All cupolas, however small, should be fitted with a volume indicator, in addition to the usual pressure gauge, and an instance is mentioned where the installation of a volume indicator was the means of saving approximately £100 per week in coke consumption alone, apart from a reduction in waster castings, and savings in other directions. In this instance, the instrument paid for itself in a few days. In the foundries which the author controls, one-quarter of a hundredweight of coke per ton of iron melted represents a sum of £10,000 per annum, and 1 per cent. loss in iron a similar figure.

In the discussion on these papers, some surprise was expressed at the heavy coke ratios mentioned by Mr. MacKenzie of 1 : 4, and also that the bed should be 40in. above the tuyere. With the poor, high cokes it was thought it might be necessary to increase the coke ratio, but with the pure cokes it was suggested that that would be defeating the object in view. More than one speaker mentioned this point.

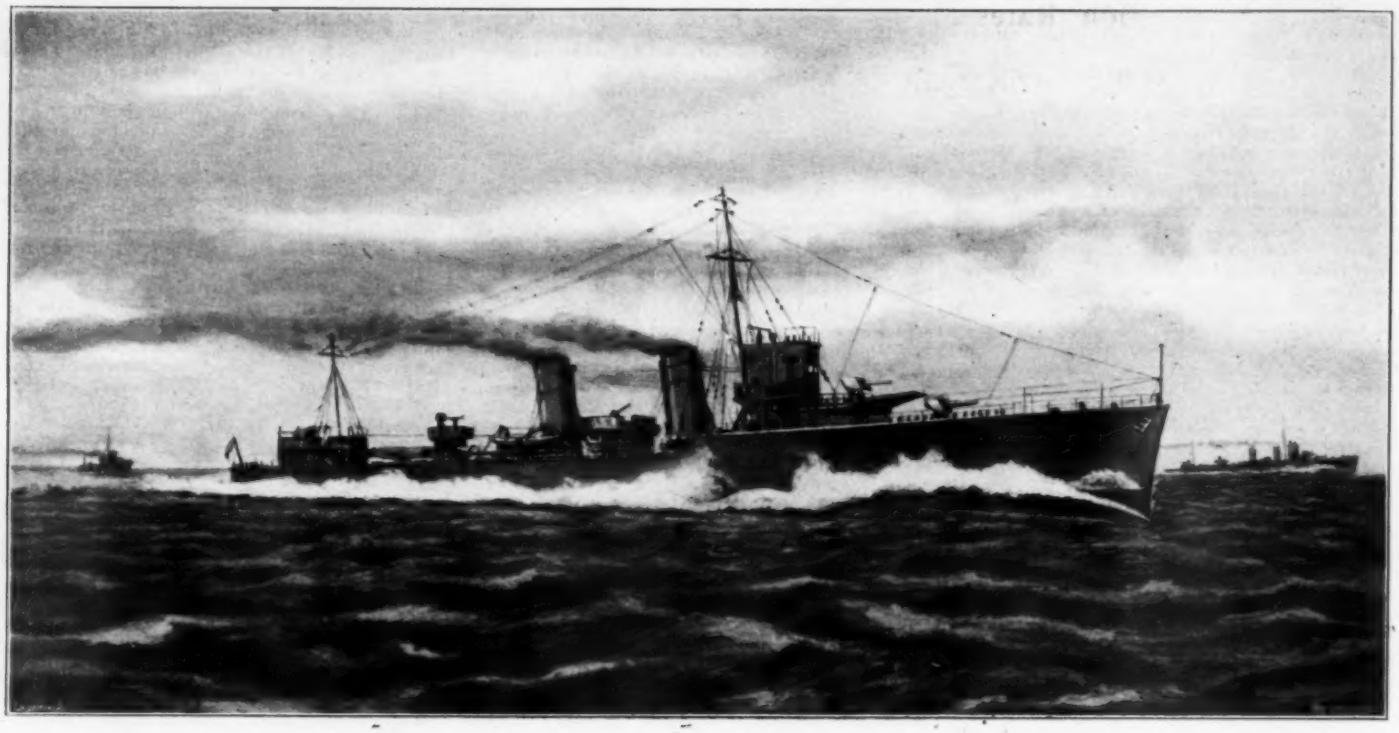
Mr. Shaw confirmed Mr. MacKenzie's point as to the importance of size of coke and its influence on the final composition of the iron, and mentioned that during the coal strike he bought some foreign coke with 0·8 per cent. S, which corresponded to his usual specification. On the first day's melt with this coke, he not only had a sluggish iron, but it proved too hard for the work. By decreasing the size of the coke, the discrepancies disappeared.

There was general agreement with Mr. Wilson's advocacy of scientific control of the air supply to cupolas. Professor A. Campion, of the Scottish branch, suggested that the best method of going to work was to arrive at the quantity of air, and then to put in tuyeres to suit, but the practice was too common of putting in the tuyeres in a more or less haphazard manner. He urged the importance of getting more knowledge of the fundamentals of the subject, so that the cupola could be made the exact instrument that all desired. The difference between the condition of the air, as between a frosty day and a warm day, was very important.

Mr. F. Hudson, speaking on Mr. MacKenzie's paper, said that coke produced by a modification of the low-temperature carbonisation process had given

DESTROYERS DESIGNED FOR THE CHILIAN NAVY

JOHN I. THORNYCROFT AND CO., LTD., SOUTHAMPTON, BUILDERS



a combustibility exceeding that of the best beehive or by-product brands, but the structure did not appear to have an open texture; it looked almost like black granite, and the largest of its cells could only be discovered with a strong magnifying glass. This material, of course, was not suitable for cupola melting conditions, and it was an illustration of the fact that the structure of a coke alone was not a reliable index.

Mr. V. C. Faulkner (past-President) exhibited a diagram handed to him by Professor Piwowarsky, which showed that if the amount of blast put into a cupola were increased from 5000 to 20,000 cubic feet per minute, the temperature would go up in a straight line, and that the tensile strength of the metal would go up parallel with it. That fact suggested that with suitable modifications, a hotter and stronger metal could be produced.

Mr. J. E. Fletcher, consultant to the British Cast Iron Research Association, speaking on behalf of Mr. MacKenzie, said the paper dealt with the melting of all-steel charges, a subject on which very little information was available, and it gave a great deal to think about if the figures were studied carefully. As regarded Mr. Wilson's paper, whilst congratulating the author on the remarkable regularity of results he had obtained, he pointed out that the work was all with one class of metal—a fairly high phosphorus iron—and under very favourable cupola conditions, so that one would get good results without a great deal of difficulty. It was in the production of the higher class irons that the difficulties and variations arose. The same cupola did not function equally well when melting an iron with 1·5 per cent. silicon and a very low phosphorous content, as when melting high phosphorus irons.

NON-FERROUS CASTINGS.

The next paper was by Professor C. H. Desch, and dealt with "Stresses in Non-Ferrous Castings." The author says that a mere knowledge of the coefficients of expansion of metals and alloys counts for little in deciding how much shrinkage will be found in a casting and that empirical measurements of actual castings of simple form are of greater value. Indications are given of various classes of stress in different metals, and it is shown how one change may partly neutralise another. Dr. Desch has recently taken a close interest in a more obscure condition of stress, viz., that which manifests itself between the individual crystal grains of a cast metal, especially in cases where gases penetrate into metals, as, for example, when hydrogen is forced by electrolysis into copper or iron. The gases penetrate along the grain boundaries, and may easily cause rupture. It has been shown that chemical action can proceed most readily along the boundaries, and when considerable stresses are present at those boundaries, the material may break up. There are, however, great differences between different castings which are still unexplained.

This concluded the reading of papers for the day. In the afternoon, visits were paid to the works of Edgar Allen and Co., Ltd., Cammell Laird and Co., Ltd., and Newton, Chambers and Co., Ltd. The annual banquet was held in the evening.

(To be continued)

The New Chilian Destroyers.

WE are now able to describe and illustrate, from a sketch, the six destroyers which the Chilian Government ordered in May from J. I. Thornycroft and Co., Ltd., and which are to be built at the firm's yard at Woolston, Southampton. They are of interest as marking a reversion to moderate dimensions in a type of vessel which has recently undergone an extraordinary development abroad. The latest French flotilla leaders, for example, are ships of 2650 tons, with a length of 466ft. overall. It is hardly necessary to point out that vessels of such great length must be gravely handicapped when manœuvring in company with destroyers of normal size and narrow turning circle.

The new Chilian boats are rather smaller than our latest destroyers. Their leading particulars are as follows:—Length between perpendiculars, 288ft. 3in.; overall, 300ft.; breadth, 29ft.; depth, 18ft. 3in.; displacement, 1050 tons. They will be driven by geared turbines taking steam from Thornycroft boilers. The designed speed is 35 knots, but it is expected that it will be surpassed on trial. As in all previous ships built for the Chilian service, special attention has been paid to the accommodation for officers and men. Owing to the immense length of the national seaboard, which extends from the Tropics as far south as Cape Horn, the crews of Chilian warships may find themselves exposed to the extremes of heat and cold in the course of a single patrol.

In proportion to their tonnage the new destroyers will be adequately armed. Each will carry three 4·7in. guns, besides smaller pieces, and six torpedo tubes. Exceptionally strong construction has been assured by adopting the British Admiralty's standard of scantlings. The lines of the hull are moulded with a view to seaworthiness combined with speed, and, as will be seen from our illustration, the profile is symmetrical and pleasing. When these six destroyers eventually join the five large British-built flotilla leaders already in service, the Chilian Navy will possess a torpedo flotilla of impressive power and mobility. That the contract for these craft should have been placed with a British yard in the teeth of keen competition from continental and American firms speaks well for the reputation which our naval designers and shipbuilders enjoy in South America. When a naval establishment is necessarily limited because of financial reasons, it is of the first importance that each new vessel should be of the most efficient design and the most durable construction. That these requirements can be met by British shipbuilders is proved by the fact that Chile, the Argentine, and Brazil all have cruisers in commission to-day which were built in England more than thirty years ago, and which are still able to come within a knot or two of their original designed speeds.

SIXTY YEARS AGO.

SOME curious inventions and quaint ideas were described in our issue of July 12th, 1867. At the Paris International Exhibition Monsieur A. Calles showed a new system which he intended should facilitate the transmission of power. The machine exhibited consisted of a water wheel almost completely immersed in a large tank. The wheel, however, was not moved by the water but by air, and was described as a "hydro-aero-dynamic-bucket-wheel." Compressed air supplied by a prime mover at any distance away was conducted by pipes to the bottom of the tank, where it was ejected in such a way as to enter the curved buckets of the wheel at a point a little beyond the centre line. The effect of the air was "continually to buoy up and elevate the side of the wheel into the buckets of which it was discharged." As the wheel turned and the buckets containing air approached the surface of the water, the air escaped from them. We did not doubt that in this way it would be quite possible to convey a certain amount of power to a considerable distance. We felt certain, however, that Monsieur Calles' "highly complicated piece of ingenuity" could only do so at the expense of an enormous loss of power in every direction. We noted during our inspection of the machine that the water contained in the tank had a considerable elevation of temperature, possibly produced by frictional effects, and caustically suggested that with a little patient prosecution of the process the water might be made to boil and so provide a secondary means for the application of power. For a quaint idea we turn to Monsieur E. D. de Chancourtois' theory of the formation of natural diamonds and his suggestion for the production of artificial stones. Monsieur de Chancourtois believed that natural diamonds were derived from the emanations of hydrocarbons just as sulphur was formed from hydro-sulphurous emanations. He held that the carbon of diamond was isolated by the "moist combustion" of a carbonated hydrogen, the whole of the hydrogen being oxidised and a part only of the carbon being transformed into carbonic acid. His theory, it was pointed out, was not discordant with the recent discovery of traces of vegetable organisms in the interior of diamonds, for it was natural that the crystallisation of the liberated carbon should be set going by a "vegetable vital force." Diamonds, Monsieur Chancourtois argued, would be formed in fissures of the earth's crust, which gave slow passage to carburetted hydrogen or carbides of hydrogen in the state of vapour. A similar condition of imperfect oxidation took place in rock oils, but the carbon isolated instead of crystallising remained entangled with the petroleum, and gave rise to bitumen. To produce diamonds artificially, he suggested that a very gentle current of carburetted hydrogen accompanied by water vapour, should be submitted to a very mitigated oxidising action in a mass of sand containing some trace of putrescible matter, such as a little starch. He thought that the artificial production of black diamond powder might already have been realised in the black soil dug up from streets in the neighbourhood of gas mains.

U.S.A. MINING INTERESTS IN SOUTH AFRICA.

IT is now understood that in all probability the American Metals Corporation will exercise its option over the properties of the Cape Copper Company in Namaqualand, which its technical advisers have been examining. If so, it will also mean that the company will, at an early period, proceed to erect a large concentrate and smelter plant near Nababeep. The Corporation's experts have, up to date, established the presence of about 300,000 tons of ore of an average value of from 5 to 6 per cent. copper, and a further large tonnage of "low-grade" rock, variously estimated at from 3,000,000 to 6,000,000 tons, containing 3 per cent. copper, in the mines of the Cape Copper Company. It is unfortunate that the English company did not make a more thorough examination of the property before coming to the conclusion that it was worked out. American companies seem to have been more impressed than British with the possibilities of South Africa's base metals and minerals. They have proved valuable deposits in various parts of the country, not only of copper, but asbestos, manganese, chrome ore, mica, corundum, &c., and, having obtained possession, are preparing to work them on a large scale. Other American concerns have experts in the country examining promising prospects. These activities, backed with almost unlimited capital, are greatly stimulating prospecting for new deposits, while a number which have been known for a long time, but the inaccessibility of which has hitherto prevented their being exploited, are again receiving attention.

Pulverised Fuel for Marine Purposes.*

By Engineer-Captain J. C. BRAND, R.A.N.

MANY years must elapse before powdered fuel supersedes mechanical stoker firing, but there is room for both. The former should be produced from fuel which is too fine for the latter or for domestic use, and also such material as may be recovered from mine ventilation, sweepings and washings. Fuel containing up to 30 per cent. of ash may be burnt, but it must be borne in mind that the ash is unproductive of heat and must be ground, conveyed, and disposed of. Including all charges, it may be assumed that the cost of pulverisation is about 2s. 8d. per ton on an output of 80 tons per twenty-four hours. Therefore, compared with fuel of 7 per cent. ash, 9¼d. has been expended uselessly in the case of fuel with 30 per cent. of ash, contrasted with 2¼d. in the case of the 7 per cent. of ash. In the case of dry fuel of 13,000 B.Th.U. per pound, having 7 per cent. of ash and 5 per cent. moisture to crush, convey, pulverise, blow and feed it to the furnaces would absorb power equal to 2·2 per cent. of its steam-producing capacity. In the case previously mentioned, *i.e.*, 30 per cent. ash and 9500 B.Th.U. per pound and 5 per cent. moisture, an equivalent of 3·0 per cent. of its evaporative capacity would be absorbed. It is evident therefore that the fuel containing the greater percentage of ash needs careful financial consideration before it is accepted as cheaper than a superior one.

Low-temperature Distillation Residue.—To a very large extent the manufacturing future of Great Britain is bound up in its ability to develop and utilise economically its main and only important raw product—coal. This sturdy warrior of past years has been seriously assailed by oil, which is commercially foreign to these shores.

Petrol engines, Diesel engines, and oil fuel burners make steady inroads on a supremacy hitherto unchallenged. Fortunately for these isles, coal contains the vital elements of its rival, and the problem of how to reclaim them has engaged leading scientists for the past decade.

A few systems now claim to have reached the practical and commercial stage, and are putting their smaller-scale development work to the severe test of daily production on a large scale. One such process produces from a ton of average coal about 18 gallons of marketable oil, 4000 cubic feet of gas and 12 cwt. of residue. It is with the residue that this paper is concerned, in the certainty that before long this fuel will appear on the market. As it is quite different in structure from the material produced by the high-temperature processes, termed coke, the term "distilled fuel" will be used as a designation hereinafter.

It is conceivable that in the initial stages, due to mistaken ideas as to the relative explosive danger of oil fuel and powdered coal, insurance companies may handicap the latter for use at sea. Such restrictions would not apply to powdered distilled fuel, which contains a low percentage of volatile hydrocarbons.

Grinding.—It is not proposed to discuss the various systems of drying or grinding fuel. It is desirable to point out, however, that for marine work a pulveriser should be economical in weight and space, should be especially designed to facilitate replacement and overhaul, and that its various component parts should be small enough to be shipped through small hatchways. Furthermore, all parts must be dustproof, from the coal feed of the hopper to the spindle accesses to the beaters and fans. No dust should blow back and find exit if any of the discharges be shut unexpectedly or suddenly. A life of at least a thousand hours, before the beaters, tangs or balls require replacement, should be insisted upon.

The power required to grind coal varies with the moisture content and the fineness of the product. Tests carried out last year by Clarke, Chapman and Co., Ltd., proved that distilled residue obtained from the "L. & N." process of low-temperature treatment required from 12 to 15 per cent. less power to grind than raw coal, and that ordinary gas coke demanded 10 per cent. more power than coal. It is not on record, however, that the moisture contents were similar in the three fuels tried. The same firm has ascertained that by using hot air or waste funnel gas at about 260 deg. Cent. entering the pulveriser as a conveying medium, the power required to grind coal is reduced by from 10 to 12 per cent.

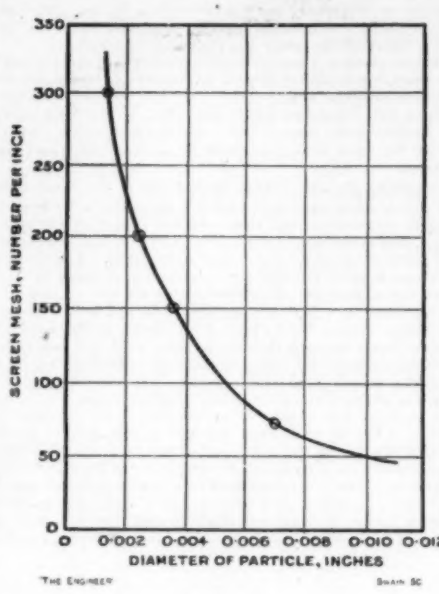


FIG. 1

It should be pointed out that it is undesirable to use a temperature of over 150 deg. Cent. except in the case of a unit pulveriser delivering the whole of its products direct to the furnace, otherwise valuable volatile hydrocarbons will be driven off and wasted to atmosphere from the separator vents of the storage bins.

Before discussing the importance of fine grinding, it is necessary to be able to visualise what is meant when 200, 180 or 100 mesh is mentioned, and the size and surface area of the fuel particle. Fig. 1 shows the relation between the diameter of the particles and the screen mesh.

Importance of Fine Grinding.—Combustion space in a marine boiler, whether of the Scotch or water-tube type, is limited, as is also the length of path available in which combustion must be completed. In consequence, long flame burners of the tubular or fish-tail type commonly used in land practice which were tried were abandoned in 1917 for use in the more strenuous conditions for which a solution was sought. Such a burner must be capable of effecting complete combustion in a distance of about 6ft., and since it is necessary for the particle to remain in the combustion zone for a certain period, it follows that to traverse a path of 30ft., such as that often given in land boilers, the particles must follow a spiral path. The spiral will gradually straighten out as the influence of the energiser, *i.e.*, the primary air, dies out. The velocity of projection is about 70ft. per second, and at completion of combustion 40ft. per second in the system with which the author is connected. The latter point is reached just before the mouth of the furnace proper.

Tests with the Brand burner, using air heated to 150 deg. Cent. and with coal containing 18 per cent. of volatile hydrocarbons, gave a temperature of 1480 deg. Cent. 15in. from the burner mouth, combustion being complete at 5ft.

The kinetic energy imparted to a small particle is less than to a large one. But the total surface area of the small particles is infinitely greater than the same weight of larger ones. Monsieur Etienne Audibert, Director of the Bureau of Mines Experimental Station at Montluçon, after a series of specific tests states: "The duration of combustion diminishes with increased fineness of pulverisation. This diminution is variable, depending upon the character of the fuel. One may in general summarise this by saying that, other things being equal, the combustion of a powder passing through a 120 mesh and over 140 mesh, will require about two to three times the time necessary for a powder of the same nature passing through a 220 mesh and over a 240 mesh." Since the kinetic energy of the lighter particle will be exhausted more rapidly than that of the larger one, it will remain longer in the intensely hot zone, surrounded by refractory material, in front of the burner.

Effect of Moisture.—Moisture in fuel, inherent and adherent, has a detrimental effect on freedom of flow, without which certainty and evenness of operation are impossible. This applies equally to bunkering a vessel or to the operation of unbunkering and feeding the burners. As regards the economics of moisture, it must be remembered that this must be evaporated either in an external drier or in the furnace. In the latter case the extra power required in the pulveriser has to be paid for, in addition to the inconvenience of choked feeders and irregular firing. As already stated, it is incumbent that the period taken for the combustion of a particle be as short as possible. After leaving the burner mouth, any moisture must first be evaporated at 100 deg. Cent. The volatiles will not commence to distil until the particle is raised in temperature to 210 deg. Cent. Heat must be absorbed from the furnace wall or from the flame to evaporate the moisture. Thus a time lapse must ensue from the entrance of the particle into the furnace to the time evaporation is completed. As the atom is probably travelling at the rate of 65ft. per second, it will be understood that in marine work the place to extract the moisture is external to the furnace.

Preheated Air.—If the primary or air accompanying the coal and used for projecting it into the furnace is cold, some time is required for its temperature to increase, since it is sluggish in absorbing radiant heat. The fuel dust absorbs radiant heat at a rapid rate, and parts with some of this by convection to the primary air which lags behind the particles in temperature. In order therefore that particle, gas envelope and air may all be near the

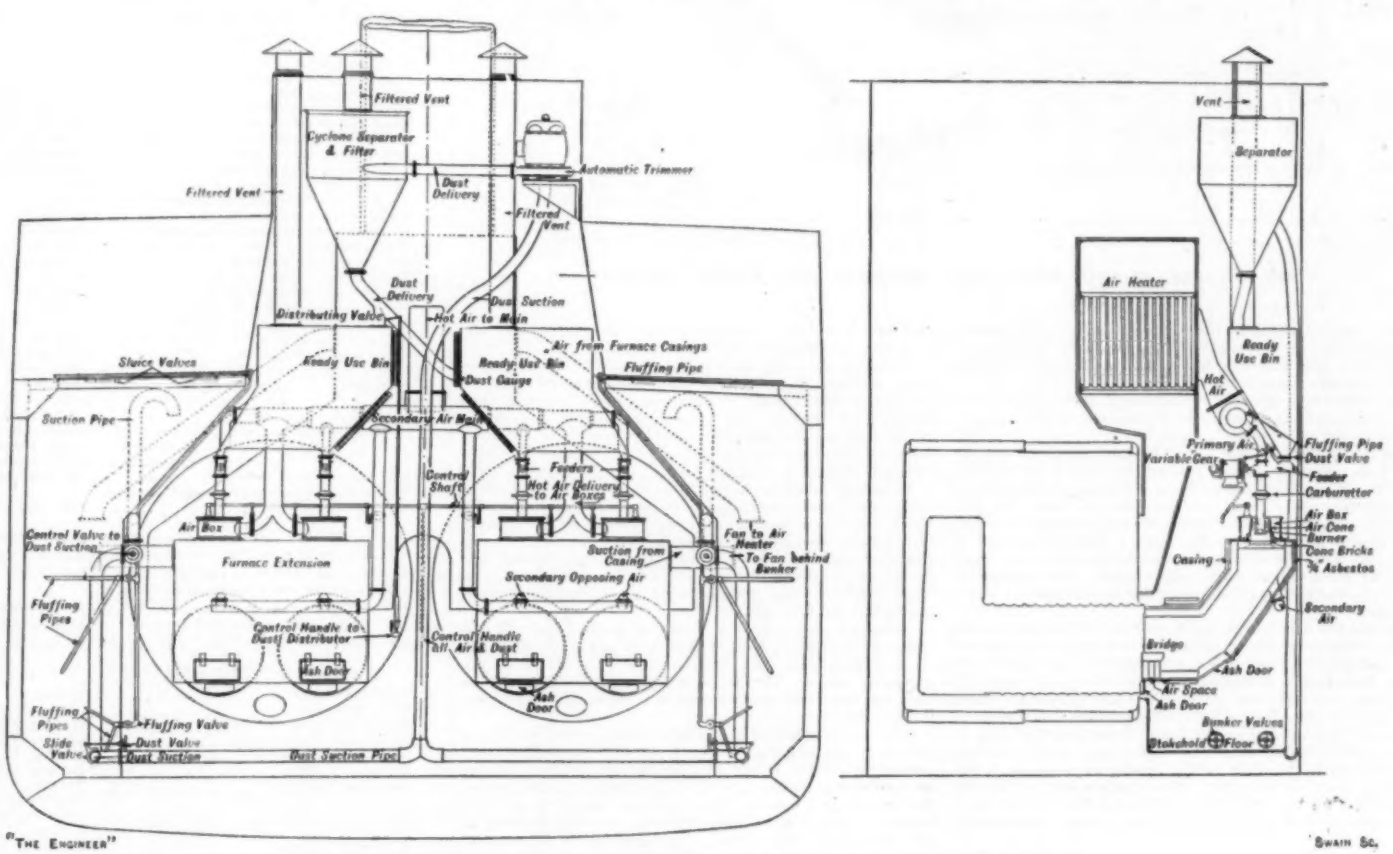


FIG. 2—THE BRAND SYSTEM OF PULVERISED FUEL BURNING APPLIED TO A STEAMER

* Institution of Naval Architects, Summer Meetings, Cambridge, July 12th, 1927. Abstract.

ignition point on entering the furnace, it is desirable to pre-heat both primary and secondary air. No loss will ensue, since all volatiles and gases liberated from the fuel will enter the furnace. It is preferred if possible to obtain a pre-heat of 230 deg. Cent. by using a heater placed in the path of the funnel gases.

Turbulent Combustion.—Just as turbulence has been found to play an important part in the combustion of oil in a Diesel engine, so it is a primary necessity for a short-flame, powdered-fuel burner. Professor A. G. Christie, in his paper on "Boiler Furnaces for Pulverised Coal"—American Society of Mechanical Engineers, "Proceedings," 1925—says: 'Summing up the factors in the combustion process, it is desirable to use thoroughly dry and finely ground coal with highly pre-heated primary and secondary air. A state of violent agitation should be maintained inside the furnace to ensure rapid contact of combustible and oxygen. Rapid combustion with consequent high furnace temperature and shorter flame travel than are present practice should result from the application of these principles."

Experiments Carried Out by the Naval Board, Commonwealth of Australia.—In 1915 the author, seized with the fact that up to that time no well oil had been discovered in Australia, and that the country was entirely dependent on external sources for the supply of this vital necessity, commenced experimenting with powdered coal for combustion in the boilers of steamships. In 1917 a small quantity of powdered coal was successfully burnt in the Durr boilers of H.M.A.S. Encounter, and in consequence the Naval Board, Commonwealth of Australia, authorised the construction and installation of a plant on H.M.A.S. Sealark. This vessel was fitted with cylindrical return-tube boilers, and upon it experiments with pulverised fuel were made with a slightly modified design of boiler furnace towards the end of 1918.

The experiments, it was considered, proved the following points:—

(1) That powdered coal can be burnt satisfactorily, as compared with other fuels for warship purposes.

(2) That it can be conveyed continuously and efficiently from a ship's bunker to the furnace, and the combustion and smoke production regulated as easily as with oil fuel.

(3) That the fuel can be delivered into the bunkers easily and efficiently.

(4) That the conveying machinery, fuel supply, &c., can be installed at comparatively low cost, without undue loss of power or excessive weight.

Storage of Pulverised Fuel.—The solid particles of powdered coal have a specific gravity of from 1·32 to 1·35, and the volume occupied by 1 ton of coal after being passed through free air is about 54 cubic feet per ton. The percentage of aeration falls rapidly to 50 cubic feet per ton, and stored in bunkers subject to a certain amount of vibration the volume drops to 46 cubic feet per ton, which may be accepted as an average figure, and was ascertained by the author after storage for seven days in a ship's bunker.

De-aerated fuel containing 4 per cent. of moisture has an angle of repose of about 33 deg. to the vertical, if allowed to stand for seven days; if this content be reduced to 1 per cent., the angle is increased to about 36 deg. Aerated by dropping through air, powdered coal becomes a fluid spreading evenly over a horizontal surface. It will flow, and may be propelled or pumped. Powdered fuel may be loaded into a ship's bunkers through a hose either by means of a pressure chamber or by means of a pump. The bunkers must be air-tight. This can usually be secured by plating up the doors and making a joint at the deck ring, the internal surface being given a coat of bitumastic enamel.

Brand System for Marine Installations.—Fig. 2 illustrates the Brand patented system for burning pulverised fuel, applied to a 240ft. steamer with a breadth moulded of 37ft., and a depth moulded of 20ft. There are two 13ft. by 11ft. boilers, each with two 3ft. 10in. diameter furnaces. Each boiler is designed for an evaporation of 10,000 lb. per hour, with an I.H.P. rating of 480 per boiler. Each boiler has 1400 square feet of heating surface. In order to secure freedom from risk of spontaneous combustion or explosion, the author observes the following precautions:

The fuel is dried and ground on shore. The grinding station may be on the foreshore, or half a mile away. No difficulty is experienced in forcing the material through pipes. The propelling agent is inert flue gas from the drier, which has been cooled and compressed to a pressure of 40 lb. per square inch. This gas contains CO_2, nitrogen and a certain proportion of oxygen and moisture, the latter greatly reduced by compression and subsequent cooling. The quantity of gas required is 5 cubic feet at 40 lb. pressure per ton of fuel. The ship end of the hose is connected to a gas relief separator fastened to the bunker lid. Before bunkering a quantity of gas is blown into the bunker through the hose; this displaces any air present. One ton of dust per minute may be forced through 500ft. of 4in. piping by a pressure of 40 lb. per square foot. Each particle of coal is sealed by inert gas, with which all the interstices are filled, to the exclusion of oxygen, consequently no vehicle exists for the propagation of flame. CO_2 being heavier than air, displaces the latter, which flows away through the separator.

On completion of bunkering the bunker lid joint is made, and the bunker sealed to prevent admission of air and its diffusion into the CO_2.

Since the compartment is air-tight, no more moisture can gather than was in the compartment when empty, except for such as is contained in the fuel dust and gas content.

Emptying Bunkers.—This proved one of the most difficult problems to surmount, as the system had to be flexible enough to remove fuel from several spaces of irregular shape, and at the same time be dust-tight. Screw conveyors and suction pipes into the dust were tried. The former were not flexible enough for large compartments of irregular form, and the dust bridged or flooded giving uncertain feeding. The suction pipes blocked and required too many inlets. Eventually a solution was obtained by leading pipes through the bunker, the inlet end being led to warm air near the boiler uptakes and fitted with a cock worked from the stokehold plates. The other end of the pipe was secured to a fan capable of maintaining a velocity flow of 80ft. per second. The weight of air required to convey 1 lb. of coal dust without deposition is 3½ lb. Ports were cut in the pipe within the bunker, and these were fitted with a cover plate worked by a lever from the stokehold. The fan discharged to a dust separator, which is fitted in its upper part with a special type of large area filtering medium, capable of shaking itself free of adherent dust. A ready-use bin capable of holding sufficient reserve

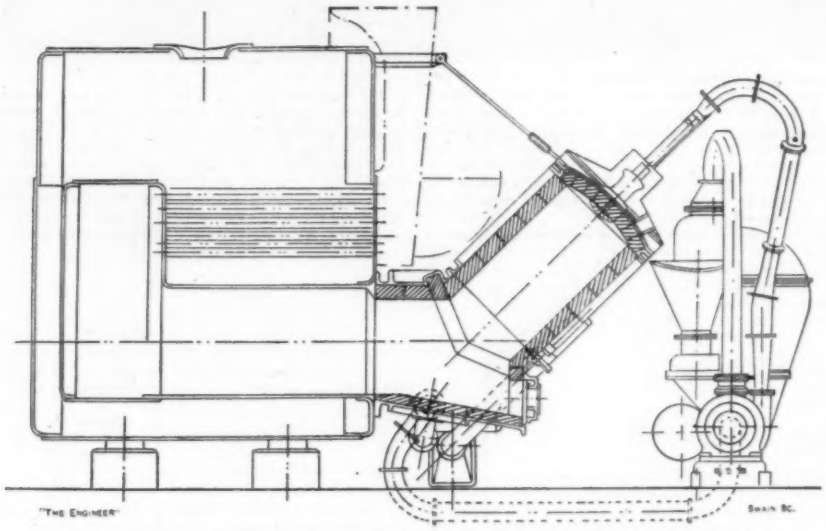


FIG. 3—CLARKE, CHAPMAN EXPERIMENTAL POWDERED FUEL BURNING EQUIPMENT

fuel for four hours' steaming was situated below the separator and received its effluent.

Partial success was achieved, and further consideration being given to the problem, it was determined to restore the fluidity of the dust by injecting inert funnel gas, thus breaking the partial vacuum formed by the evacuation of the coal and restoring the aeration to normal. Success followed this innovation, and the dust flowed regularly without sticking or bridging.

As before mentioned, funnel gas is abstracted, cooled, compressed, and stored in a reservoir. The pipe from the latter is led into the dust at a few points, and by opening the cock at an interval of two hours for a few minutes trouble is averted. This is called the fluffing system, and by its use powdered fuel will flow from a 'tween deck to a lower bunker. The pressure used is slightly above that due to the head of coal.

Ready-use Bin.—This is fitted to provide storage for sufficient fuel for a limited period of steaming, and also as a settling space for the material received from the separator above. The bin is dustproof. One bin may be used for the whole boiler-room or a separate bin to each large boiler.

Feeder.—Consists of a casting secured to the bottom of the ready-use bin, the access to which is controlled by a dust-tight valve. It has also an inlet for primary air and an exit for dust and air mixed. A machine-cut screw feeder, having one end housed for a sufficient length to prevent flooding, rotates in a casing and feeds the dust forward to the down pipe. The screw is manipulated by a variable-speed gear, motor driven. The feed of coal requires a range of from 60 lb. per hour up to a maximum for a large furnace of 700 lb. per hour, and is designed in ranges of 300 lb., 500 lb., and 700 lb. The horse-power required for these is 0·5, 0·75 and 1 per feeder.

Carburetter.—The function of this is intimately to mix the dust and air and prevent the fuel dropping down the centre of the pipe. It is very important to prevent stratification. The carburetter is fed with hot primary air. As will be seen from the sketch, it consists of a removable diaphragm of 80-mesh gauze wire of sufficient total area to pass all the air and coal with allowance for frictional loss. The diaphragm can be rotated half a turn and bumped against a stop. This is to enable material that will not pass the mesh to be shaken off into the furnace.

Burner.—This consists of a wrought iron tube, whose exit end is conically expanded. Into the extra area thus formed, a cast iron cone of a different angle to the pipe is inserted. The cone is secured to one and a-half turns of worm of pitch about one and a-half times the diameter of the pipe. The worm is fastened in the pipe. The other end of the burner pipe is fitted with a handle, and terminates in a gland packed with one turn of asbestos. The burner pipe slides on the pipe leading from the carburetter.

Air Cone.—The function of this is to provide the secondary air required, and to impart to it a tangential motion. The cone is built of cast iron, and one end of it is recessed to carry a ring of fire-brick, 1in. to 1¼in. thick. Just behind these in an axial direction the air vanes commence. These are given an angle of 45 deg. The back of the cone is kept away from the air casing, and a certain volume of air flows through this space. This provision ensures that all the dust is projected into the furnace and that none falls into the air box.

Air Box.—This is secured to the furnace extension, and receives the secondary air pipe. The latter is fitted with a control air valve. On the front or top of the air box through which the burner pipe passes are secured spectacle plates to permit of cleaning any slag that may adhere to the cone, a mica observation window and a small cleaning door.

Extension Furnace.—This is built out from the furnace, and in the design provision is made for air circulation outside the brickwork, air-cooled bridge, door at bottom of furnace proper for clearing dust, ash door to the furnace extension to permit access to the back end or brickwork, and to provide for clearing ashes or slag. The extension also allows of the smoke-box doors being opened, and of a walk-way below it for the attendant. Its shape also gives the necessary changes of direction and velocity to deposit slag particles.

Operation of the Boiler.—The ready-use bin having sufficient coal in it, the fan is started at low speed, and air admitted to the primary pipe. A lighted torch made of oily waste is passed through the rectacle hole to the front of the burner. The latter is drawn back to the inner edge of the cone brickwork. The feeder screw is then started at lowest speed, no secondary air is required. At the end of five minutes the torch can be withdrawn. In fifteen minutes the cone bricks will be sufficiently warm to support combustion, and the feeder pipe can be advanced farther toward the furnace. It is inadvisable to exceed a feed rate of 60 lb. per hour until the refractory in the furnace extension reaches a temperature of about 500 deg. Cent. The primary air supply will be sufficient till an input of 100 lb. of dust an hour is reached, then secondary air should be admitted. As soon as the brickwork is incandescent and the temperature of the wall of the furnace proper reaches about 120 deg. Cent., the primary air can be opened out and the secondary air regulated for the input of dust and power required.

If the regulation set forth above is not adhered to in lighting up, the bottom of the furnace and the tubes and smoke-box fill with unconsumed particles, and dust gulps into the stokehold from the cracks of the smoke-box door; also the heating surface is partially choked before the real steaming work of the boiler commences.

TABLE I.

Single-ended Marine Boiler, 9ft. long by 10ft. 3in. external diameter. Two Furnaces, 2ft. 10in. diameter.

Duration of test	3¼ hours
Boiler pressure, lb. per square inch	143
Feed temperature	137 deg. Fah.
Smoke-box temperature	595 deg. Fah.
Back-end temperature	740 deg. Cent.
Furnace temperature	1,380 deg. Fah.
Primary air inlet temperature	285 deg. Fah.
Secondary air temperature	550 deg. Fah.
Air pressure in primary air pipe	3in.
Air pressure in second air chamber	0·2in.
Boiler heating surface, total	680 sq ft.
Boiler heating surface, tubes only	466 sq. ft.
Total fuel fired	1,887 lb.
Total water evaporated,	13,810 lb.
Fuel fired per hour	539 lb.
Water evaporated per hour	3,947 lb.
Water evaporated per lb. of fuel	7·33 lb.
Water evaporated per lb. of fuel from and at 212 deg.	8·25 lb.
Efficiency	67·4 per cent.
Power to pulveriser	16·5 amps.
Fuel used	Leicester ("L. & N." fuel)
Calorific value of fuel	10,600 B.Th.U.
Grading of fuel	98·75 per cent. through 76 mesh 97·75 per cent. through 100 mesh 85·55 per cent. through 180 mesh
Combustion space in boiler	167 cubic feet
Combustion space with extended combustion chamber	223 cubic feet

Further Tests with Marine Boilers.—Clarke, Chapman and Co., Ltd., have interested themselves in the question of pulverisers, pulverised fuel and the use of this fuel in Scotch boilers at sea. They have carried out a number of trials with different types of burner and carrying arrangement of furnace front. In the first attempt they unknowingly followed closely on the lines of discarded experimentation in both Australia and the United States, the usual bricked-up furnace and burner at the furnace mouth appears. Up to 250 lb. of dust per furnace was consumed, but a considerable amount of partially unburnt

TABLE II.

Duration of test	1½ hours
Boiler pressure	140 lb. per sq. in.
Feed-water temperature	130 deg. Fah.
Smoke-box temperature	630 deg. Fah.
Back-end temperature	710 deg. Fah.
Primary air inlet	250 deg. Fah.
Secondary air inlet	700 deg. Fah.
Power taken by pulveriser	19·5 amps.
Furnace temperature	1,575 deg. Cent.
Pounds of water per lb. of fuel	6·65 lb.
Fuel fired per hour	585 lb.
Water evaporated per hour	3,890 lb.
Heating surface	680 sq. ft.
Water evaporated per square foot per hour	5·72 lb.
Water evaporated from and at 212 deg. per lb. of fuel	7·53 lb.
Water evaporated per square foot at 212 deg.	6·47 lb.
Efficiency	65·2 per cent.
Calorific value of fuel	10,000 B.Th.U.

fuel was carried through the tubes into the smoke-box. Ignition of this unburnt fuel and carbon monoxide took place in the smoke-box. In the next stage the furnace brickwork was reduced, and the furnace mouth extended, the hanging bridge left in position.

Tests showed that 400 lb. of fuel could be burnt per hour with a carry-over to the smoke-box, the temperature of which was 400 deg. Cent. A furnace temperature of 1400 deg. Cent. was recorded.

Fig. 3 shows the next step. Here all the furnace brickwork has been removed, and the furnace further extended. Opposed burners are introduced, also induced secondary air, which is heated in a casing around the brickwork. Test sheets of trial with the Clarke, Chapman system, using "L. & N." distilled fuel produced from Leicester coal are given—Tables I. and II. This test is of great interest, confirming previous ones, in which it was found that the residue from low-temperature distillation burns with as much facility as coal containing a high percentage of volatile hydrocarbons. Messrs. Clarke, Chapman are to be congratulated on the efforts which they have made to evolve a satisfactory solution.

Unit Pulverisers.—There are on the market some excellent types of these machines, though their weight is somewhat excessive for the output. This doubtless arises from the fact that they have been designed for use on shore, where neither weight nor space are matters for serious consideration. The conditions existing at sea with regard to output are adverse for a wind-swept machine if connected direct to the boilers. It will be seen from previous remarks that fineness of grinding, instant variation of output and control of air supply, are essential for efficiency, and that no dust must escape from the pulveriser if the ground fuel outlet is suddenly shut.

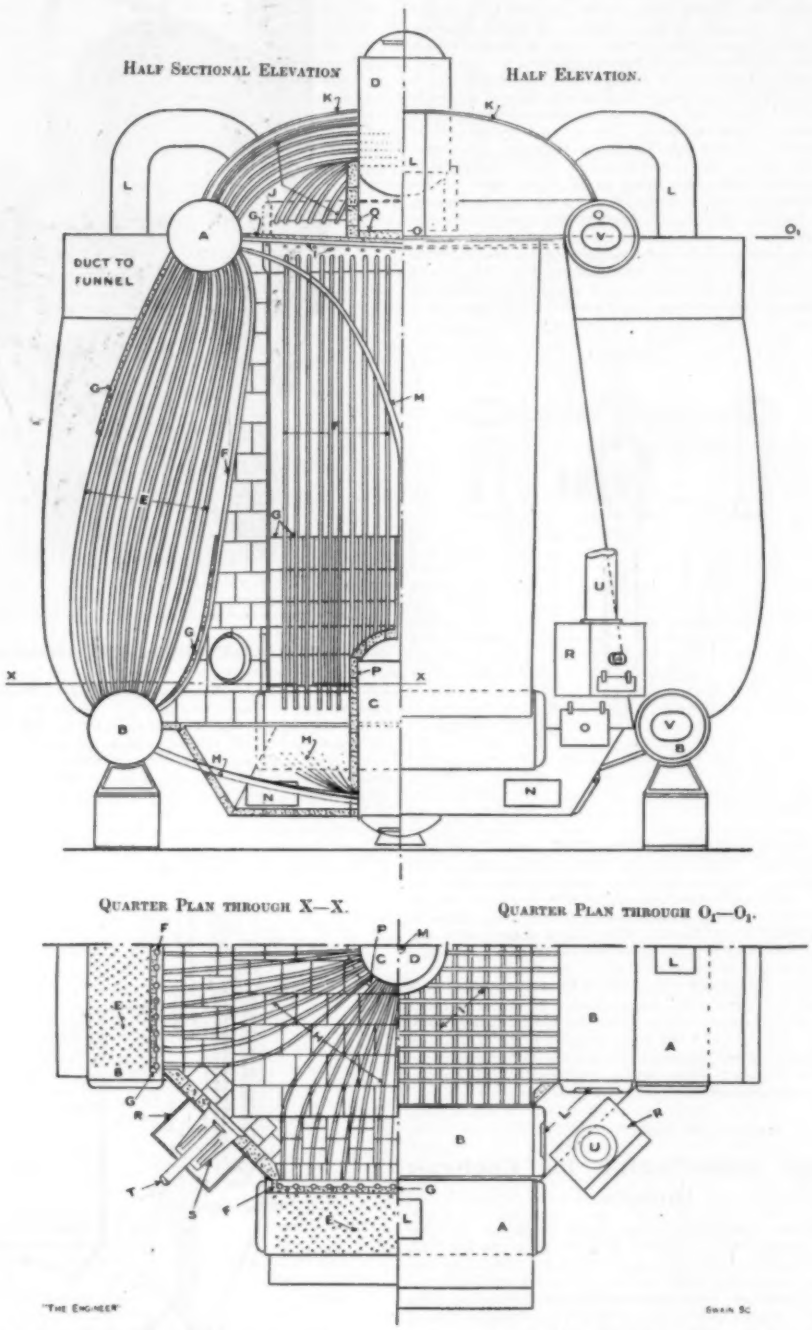
With this type of pulveriser the fineness of its product depends on the density of air current created by its fan, which is maintained by the velocity of the latter. If the speed of the fan is kept constant and the inlet or outlet throttled, the velocity of the air falls in the passages beyond, therefore a constant definite fineness of grind cannot be maintained irrespective of the speed of the fan and the quantity of air passing through it. Nor can satisfactory relief be sought in strangling the coal feed, since the feed is not absolutely regular at all rates of input. The quantity of air passing must be maintained to obtain a constant mesh product, therefore when the feed is throttled a much larger proportion of air passes through the primary feed pipe than is desirable to burn the weight of dust entrained. These remarks only apply to any idea that might be formed of connecting the unit pulveriser direct to the furnaces.

Where a unit machine has to be carried on board it should be situated in a small well-ventilated compartment of its own, and deliver through a separator to the ready-use bin in the boiler-rooms. This type of pulveriser has a distinct field on land, where the output required is almost constant, and the exigencies of slow steaming, starting and stopping have not to be met. It is cheaper, more convenient and less cumbersome than its competitor, the grinder and drier.

Where it is decided to install a unit grinder on board ship, the coal should be fed to it mechanically or pneumatically, and hot funnel gas introduced at the inlet, care being taken that the temperature at inlet does not exceed 150 deg. Cent. More funnel gas may be introduced at the delivery end at a temperature of 200 deg. Cent. The lower limit is set at entrance because tests have shown that an increase of temperature of 22 deg. Cent. is often derived from the action of the beaters. On arrival of the mixed hot fuel and gas at the ready-use bin, the gas will pass to atmosphere, and the fuel to the receptacle provided.

The fact must not be lost sight of that the cost of pulverising has to be paid for, whether this duty is performed on board ship or on shore.

The illustration reproduced in Fig. 4 shows a protected design for the Brand radiant vertical water-tube boiler. The legend below the elevation and the two plan sections provides a key to the various parts of the boiler and the burners for pulverised fuel.



A, cylindrical steam drums, four in number.
B, cylindrical water drums, four in number.
C, cylindrical feed drum and hot spot.
D, superheated steam drum.
E, generator tubes.
F, water screen tubes.
G, refractory screens.
H, water screen ashpit.
I, water screen roof.
J, superheated tubes heated by gas admitted through ports in G
K, superheater drum and roof supports.
L, ducts from superheater to funnel duct.
M, various pipes from hot point to A.
N, ash doors.
O, access door to furnace.
P, refractory lining of hot point.
Q, refractory screen to base of superheater drum.
R, air box for admission of secondary air.
S, air cone.
T, primary air and powdered fuel burner pipe.
U, secondary air pipe.
V, manhole doors.

FIG. 4—BRAND RADIANT VERTICAL WATER-TUBE BOILER FOR POWDERED FUEL

Institution of Mechanical Engineers.

SOUTH WALES BRANCH.

ON Thursday, 7th inst., the members of the South Wales Branch of the Institution of Mechanical Engineers, accompanied by the President, Sir Henry Fowler, and the chairman of the Branch, Mr. C. J. T. Billingham, and friends, paid a visit of inspection to the Cardiff Docks, where they had an opportunity of inspecting the latest coal-shipping appliances and the new electro-hydraulic power station.

Much interest was shown in the operation of four 30-ton coal hoists, supplied by the East Ferry-road Engineering Works Company, Ltd., Millwall. Three of these hoists have a maximum lift of 60ft. above the coping and one of 70ft. The coal wagons are delivered to the hoists by electrically-operated traversers driven by two 35 horse-power motors. Each traverser has electrically-operated "tip-ups" for running the wagons on to the hoists and off again to the empty roads when they have discharged their contents. The tip-ups are fitted with automatic wheel stops to control the position of the wagons on the traversers. The hoists, which weigh 35 tons each, are propelled for berthing purposes by two 20 horse-power electric motors through gearing at a speed of 30ft. per minute. Current at 440 volts, three-phase, is supplied by overhead wires and slipper type trollies.

The cradles, which are suspended by wire ropes, are lifted by multiple power hydraulic rams, and when the discharging height is attained, the wagons are tipped to an angle of 45 deg. on a tipping table operated by an auxiliary ram. Each hoist is equipped with two hydraulic cranes of 6 tons and 3 tons capacity respectively, the heavier crane being for carrying an "anti-breakage" box, and the smaller for adjusting the chute point extension pieces in the chute or for any other ligh twork. Pressure water for these hoists is supplied through a 9in. main and a 7in. auxiliary main, the connections being made by "walking" pipes to the hydrants. Under favourable conditions coal can be shipped up to the rate of 1000 tons per hour with wagons of 20 tons capacity.

The hydraulic power station, which was also inspected, contains four electrically-driven multi-stage turbine pumps supplied by the Pulsometer Engineering Company, Ltd. Each has a capacity of 800 gallons per minute of pressure water at 800 lb. per square inch. The water is drawn from the East Dock and is mostly fresh, as the dock is supplied by a fresh water feeder from the river Taff. A culvert extends from the East Dock to the Roath Dock, and from there a branch is taken to supply the well, from which the water is pumped by two sets of low-pressure centrifugal pumps to an overhead tank having a capacity of 40,000 gallons. The elevation of this tank is such that about 20 lb. pressure per square inch of suction head is provided for the three-phase main pumps. The low lift pumps, two in number, are driven by motors of 105 horse-power each, which run at 965 revolutions per minute. The rated capacity of these low lift pumps is 4000 gallons per minute, against a head of 50ft. This volume will fill the supply tank in 10 minutes, one low lift pump being sufficient to supply more than the maximum output to the four main pumps, running simultaneously. The supply tank is connected to two ground tanks by a 15in. diameter main, one at Roath Dock and one at Queen Alexandra Dock.

The four main pumps are driven by 650 horse-power, 6600 volt, three-phase, 50-period motors, at 1470 revolutions per minute. The pumps are in two sections, the low-pressure comprising seven stages and the high-pressure six stages. Automatic control is arranged for so that each pump will be stopped in case of shortage of water supply or a burst main. The main contactors are of the air break type, and arranged for starting and stopping the main motors up to forty times an hour. The automatic control of the main pumps is actuated from the flow in Venturi meters on the pump intakes, and the sets are started one after another in rotation and shut down in the reverse order according as the demand rises and falls. The selector switch is arranged so that the four sets can be started in any order. There are four single-phase transformers for reducing the voltage to 220 volts for the low-pressure pumps, contactor gear, switches, &c. The special feature of these pumps is that when the pressure water falls on account of increased demand, the pumps will deliver more water up to 1000 gallons per minute at a correspondingly reduced pressure. The motors are by the Metropolitan Vickers Company, Ltd., and the automatic control gear by Electric Control, Ltd., Glasgow.

After the visit to the docks the members had luncheon together in Cardiff prior to making a char-à-banc tour through the Vale of Glamorgan to Bridegend, and in spite of unfavourable weather conditions during the visit to the docks, the day's proceedings were thoroughly enjoyed.

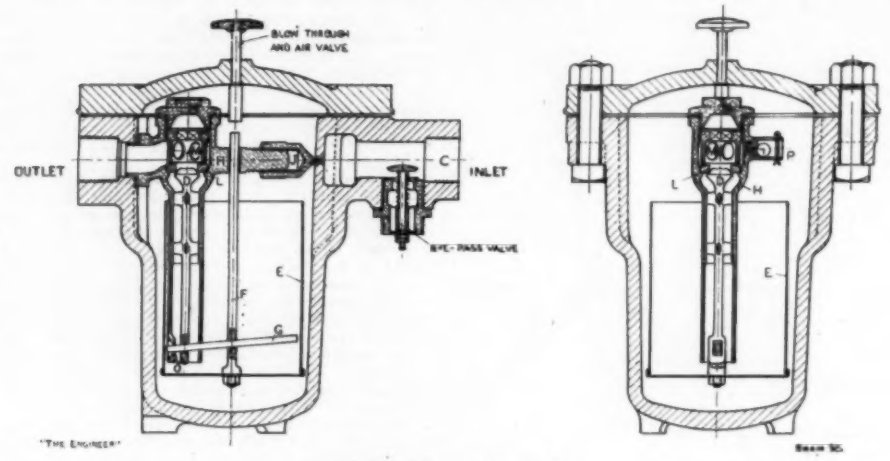
MERCHANTS in Peking and Tientsin are, according to the *Far Eastern Review*, interesting themselves in a proposal to reopen the Grand Canal between Tientsin and Tungchow. The scheme is induced by the shortage of trucks on the railway and the high tariff for railway service. It is proposed to engage war and famine refugees for the work of dredging.

A New Steam Trap.

A STEAM trap, simple in construction and of compact form, intended for steam pressures up to 150 lb. per square inch, has recently been introduced by Lancaster and Tonge, Ltd., of Pendleton, Manchester. The trap is of the bucket pattern, and resembles previous traps made by the firm, with the important difference that the leverage of the bucket to open and close the valve is obtained in a simpler manner than formerly.

As shown in the sectional drawing, it consists of a cylindrical body furnished with a removable cover. There is a free inlet for steam and water at C, and the outlet is controlled by a valve D. This valve is operated by the motion of the bucket float E, to which it is connected by the rod F and the lever G in such a manner that the float has a leverage of 5 or 6 to 1 over the valve when opening or closing it. When water enters at C, it first fills the space outside the bucket E, and finally flows over the top until the bucket loses its buoyancy and sinks to the bottom. In so doing the bucket opens the valve D, to which it is connected, and the water is rapidly discharged, so that the bucket again becomes buoyant, and rises and closes the valve D. When the bucket is again filled, the cycle of operations is repeated.

The part H is a bronze casting, which is held against the outlet flange by means of a nut J, which is screwed against the deflecting plate K at the inlet. The seating L, which is of nickel, is held in position by a cage M screwed into the part H, and can be easily withdrawn by unscrewing the cap N. The valve D is a nickel casting with guiding wings. The stalk at its lower extremity embraces the operating lever and makes contact with it by knife edges. The operating lever G, which is of bronze, also pivots on knife edges at O. It passes through a slot in the float spindle F, where there are also knife edges. It will be understood that as the valve spindle is considerably nearer the slot O than the rod F the necessary leverage to close the valve D is readily obtained.



BUCKET TYPE STEAM TRAP

The " blow through " device fitted in the lid also serves as an automatic air valve as it does not rise on to its seat until there is sufficient steam pressure in the trap to lift the valve, when air escapes through the clearance round the spindle. An auxiliary air valve P is also inserted in the fitting on the outlet side of the valve. It consists of a bronze ball which rises on to its seat to cover a small hole when a predetermined pressure is attained.

A by-pass valve can be incorporated in the inlet branch when desired in the position shown in the drawing. In that case a mushroom valve of large area is held open by a light spring, so that the initial flush of cool water, common to all steam using plants during the warming up period, can be allowed to escape. When the pressure rises as the system to be drained " warms up," the valve closes automatically, the actual closing pressure being determined by the strength of the spring. The trap then assumes its normal cycle of operations. The trap is made in sizes to deal with 150 to 1000 gallons of water per hour.

The Quarter's Shipbuilding Returns.

LLOYD'S Register Shipbuilding Returns for the quarter ended June 30th, show that the tonnage under construction in Great Britain and Ireland—1,390,388 tons—was 173,456 tons more than at the end of March, 1927, and about 549,000 tons more than the tonnage being built twelve months ago. The tonnage on which work was suspended at the end of June, 1927, amounted only to 8745 tons, as compared with 77,600 tons at the end of June, 1926. The present totals, although the highest since September, 1924, are still 500,000 tons below the average tonnage being built during the twelve months immediately preceding the war, *i.e.*, 1,890,000 tons.

The tonnage under survey of Lloyd's Register amounted to 1,287,913 tons, which represents 92.6 per cent. of the total tonnage under construction. A considerable decrease was shown in the tonnage commenced during the quarter, namely :—437,112 tons, as compared with 579,839 tons during the first quarter of this year. The tonnage launched during the past quarter—268,545 tons—showed the large increase of 140,798 tons, as compared with the figures for the previous three months.

The total merchant tonnage being built in other countries —1,450,157 tons—was about 97,000 tons more than at the end of March, 1927. The tonnage under construction abroad still exceeds by 60,000 tons the tonnage being built in Great Britain and Ireland. The figures for the leading countries abroad are :—Germany, 407,620 tons; Italy, 226,774 tons ; Holland, 171,825 tons ; United States, 146,846 tons ; and France, 136,474 tons. From one of the tables we see that 336,503 tons were commenced abroad and 309,223 tons were launched, a decrease, as compared with the previous quarter, of 30,523 tons in the tonnage commenced, but the large increase of 148,175 tons in the tonnage launched.

The total world tonnage under construction shown in another of the tables—2,840,545 tons—shows the large increase of about 271,000 tons, as compared with the previous quarter, but is still 606,013 tons below the highest pre-war record reached on June 30th, 1913, viz., 3,446,558 tons. There are at the present time under construction in the world 31 vessels of between 10,000 and 20,000 tons each and 12 of 20,000 tons and upwards. Fourteen out of the 24, and five of the larger vessels, are being built in Great Britain and Ireland. The total figures include 112 steamers and motor ships, each of over 1000 tons, with a total tonnage of 725,426 tons, under construction in the world for the carriage of oil in bulk. Of these tankers, 65 of 400,992 tons are under construction in Great Britain and Ireland, and 10 of 79,170 tons in France.

The tonnage of vessels now being built in the world which are to be fitted with internal-combustion engines amounts to 1,459,595 tons, while the tonnage of steam vessels under construction is 1,366,809 tons. The motor tonnage is thus for the first time larger than the steam tonnage. In Great Britain and Ireland the motor tonnage under construction amounts to 627,700 tons, equal to 82.8 per cent. of the steam tonnage under construction. In Danzig, Denmark, Holland, France, Italy and Sweden the motor tonnage under construction greatly exceeds the steam tonnage, the combined totals for these countries being 561,135 tons of motor ships and 152,055 tons of steamers. The world figures include 84 motor ships each of between 6000 and 10,000 tons ; 17 of between 10,000 and 15,000 tons ; 9 of between 15,000 and 24,000 tons; and 1 of about 33,000 tons.

Another table shows that the total horse-power of the engines being built or installed on board vessels at the end of June, 1927, amounted to 2,021,074 H.P., of which 939,782 H.P. are being built in Great Britain and Ireland ; and 238,160 H.P. in Italy. The world figures are not, however, complete as the horse-power of turbines being built in Germany is not available.

Of the vessels under construction in the world—which total excludes vessels the construction of which has not actually been commenced and also all vessels of less than 100 tons—409 of 2,016,897 tons are under the inspection of the Society's surveyors, with a view to classification in Lloyd's Register Book, which represents 71 per cent. of the world tonnage under construction.

A New Superheater for Cochran Boilers.

ALTHOUGH superheaters have been employed successfully for many years on boilers of different types for both land and marine work, their application to vertical boilers has so far been somewhat limited. Progress in this direction has doubtless been retarded by the prevailing idea that most vertical boilers are too small to make the fitting of a superheater worth while, added to which it is often very difficult to arrange a well designed superheater within the small space available for such an attachment.

In the accompanying illustrations we show a new arrangement of superheater which has been designed by T. Sugden and Co., Ltd., of 180, Fleet-street, E.C. 4, specially for use with vertical boilers of the Cochran type. Such boilers have achieved considerable success in both industrial and marine circles, and, in particular, many boilers, some of them of large size, built by Cochran and Co., Ltd., of Annan, are now fitted on motor vessels for supplying steam for engine-room and deck auxiliaries and general heating purposes. The steam has often to be carried through long and exposed pipes, and for deck services it is frequently only used intermittently. The economy and advantages of dry and superheated steam for such work are very evident.

The particular boiler we illustrate is one recently supplied for industrial purposes to Mather and Platt, Ltd., of Manchester. It has a diameter of 6ft., with a height of 14ft., and is provided with 350 square feet of heating surface. The working pressure is 170 lb. per square inch, and the superheater is designed to deliver steam at a total temperature of 475 deg. Fah., or with 100 deg. superheat. Fig. 1 shows the general arrangement of the superheater chamber, which is riveted on to the boiler combustion chamber plate, and is supported beneath by two angle stays, which are secured to the base of the boiler shell. Fig. 2 shows a section through the combustion chamber of the boiler and the superheater unit. As is the case with all Cochran boilers, the upper part of the combustion chamber is lined with fire-brick, and the superheater elements are so disposed that they receive radiant heat from the hot fire-brick around the entrance to the smoke tubes. A protecting lining is carried well up the combustion chamber, so that the flame does not come in direct contact with the superheater tubes. The arrangement shown is, we are informed, suitable for coal-fired and oil-fired boilers. The number of superheater tubes can be varied to suit any degree of superheat required.

It will be seen that the headers are of square section.

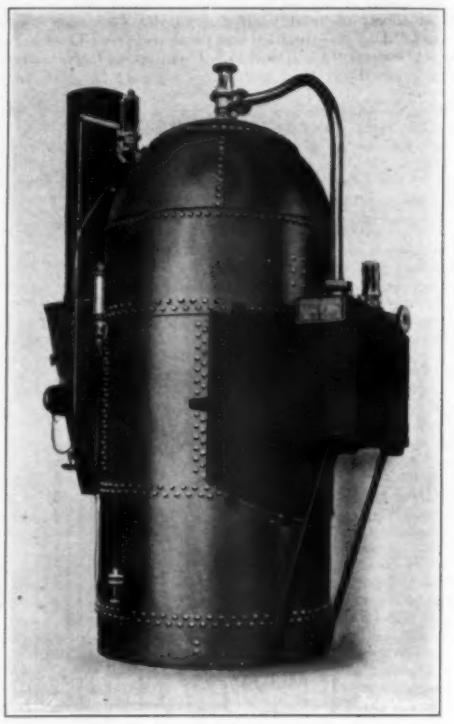


FIG. 1—COCHRAN BOILER WITH SUPERHEATER

They are made of wrought steel and the U tubes are expanded and bell-mouthed into the lower sides. Directly above the tubes, which are arranged in groups of four, there are hand hole covers, which are made in stamped steel, and have an inside joint. Each door is held in position by a substantial clamp and bolt. On removing a cover ample space is given for inspection or expanding and plugging should this be necessary. The superheater is provided with drain connections and a thermometer and safety valve are supplied.

The arrangement we show may also be adapted to suit

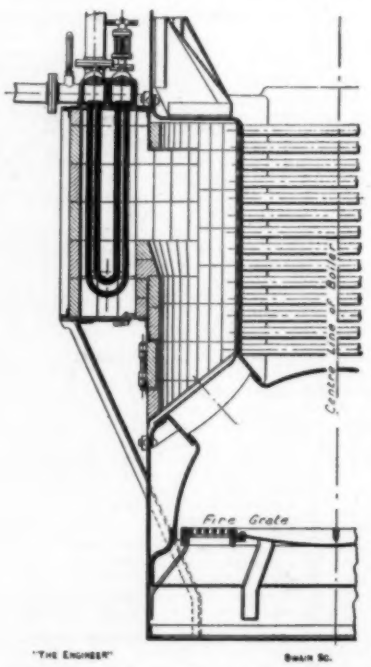


FIG. 2—COMBUSTION CHAMBER AND SUPERHEATER

existing Cochran boilers, which have not been specially built for a superheater attachment. For such boilers a simple structure of fire-brick reinforced with steel members is carried up from the floor at the back of the boiler to surround the superheater chamber and to support the headers.

The type of superheater which we have described and illustrated has, we understand, been submitted to exhaustive and lengthy tests in the power-house of Cochran and Co., Ltd., at Annan. We learn that the opinion formed from such tests, which included overtime and night-shift working, was that a reduction of 25 per cent. in the amount of steam used was possible, which represents a considerable economy in fuel.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Birmingham Quarterly Meeting.

THE quarterly meeting of the Midland iron trade held in Birmingham to-day (Thursday) was well attended, but though considerable discussion on possible trade developments during the third quarter of the year took place, little actual enlightenment resulted. No definite gauge of trade tendencies was forthcoming. Constructional engineers have lately booked additional business, which will go some way towards maintaining employment pending the quickening of trade in the autumn, which everybody hopes for, and the execution of which will involve the use of a fair amount of steel. Engineers were not disposed to place contracts for even that material, however. They state that orders for steel are being withheld from home producers because prices are too high. A large amount of business in finished material as well as in half-products is, it is claimed, being diverted to the Continent, where prices are lower. A further reason given for their hand-to-mouth policy of buying is that the iron and steel industry is so over-equipped that with the fuel situation secured for the time being, consumers think they can safely leave their requirements to be satisfied as they arise. Iron and steelmasters, for their part, state that prices cannot fall much lower, profits already having been reduced to the minimum. On 'Change to-day the view was expressed that consumers are beginning to realise the difficult position of producers, and now that the half-yearly stock-taking is over, a release of orders is anticipated. Indeed, some South Staffordshire mills are reported this week to have been booking more business. Whether that is attributable to the replenishment of stocks or to an improved consumptive demand they are not, they say, at present in a position to judge. Generally speaking, business this week was little better than at the last meeting, and up to the time of writing the market was no further forward in the matter of future prices. Producers were disinclined to accede to consumers' entreaties for lower figures, and the latter were not disposed to place business at current rates.

Staffordshire Bar Iron Prices.

There is not enough work in the Staffordshire finished iron trade to ensure regular employment at the mills. And although ironmasters are of opinion that no useful purpose would be served by making price adjustments, prices have weakened in best quality iron, Crown and common bars. The reduction of 20s. this quarter in marked bars stimulated demand hardly at all, and a like fate would in all probability befall any other such price movement. On 'Change to-day, therefore, it was the considered opinion that no revision of the marked bar basis is to be expected in the new quarter. Readjustments are in progress in other departments of the finished trade, however. Crown bars, which up to now have been quoted £10 15s. to £11, could doubtless be bought at £10 10s. if any substantial orders were in prospect. Common bars of nut and bolt and hurdle quality, which have been in the region of £10 5s., now range from £9 15s. to £10. Even this, however, is so far in advance of the Belgian price that only occasional orders for filling up gaps fall to the lot of the local mills. Wrought iron gas tube strip is also cheaper, many sellers quoting £11 17s. 6d., a reduction of 2s. 6d. per ton on recent figures.

Steel Values.

The business being offered in the steel department is such that steelmasters are not disposed to reduce prices to secure it. Demand shows no sign of expansion, and buyers continue to hold off for lower prices. It is thought that, if orders of sufficient magnitude were in prospect, price adjustments might be made, but the inquiries circulating relate only to comparatively small tonnages. The rolling lists issued from the mills indicate a wide variety of material to be rolled, generally a sign that larger orders are needed. The plate mills are known to be needing specifications. Continental competition continues unabated and offers of foreign steel are received at "cut" rates through Birmingham merchants. One received this week from a Belgian exporter offered No. 3 iron bars and flats at £5 17s. 6d., mild steel, £5 19s.; steel rods, £6 11s. 6d.; and rolled steel joists, £6; these prices covering delivery into Birmingham and district. These terms leave a considerable margin below British steel. Whether during the quarter local steelmakers will, in an effort to secure some of the business which is going abroad, lower their standard prices, remains to be seen. At the moment they adhere to recent quotations. In the semi-finished department continental quotations are still very weak, billets being obtainable at £5 5s. to £5 7s. 6d. Native steelworks ask £6 15s. minimum for their output.

Galvanised Sheets.

Galvanised sheet mills to-day reported a fair inquiry from all the usual overseas markets. India continues a good customer, and Central America and South Africa are also buying substantial quantities. The Mediterranean market is not so good, sheet makers in Czecho-Slovakia competing keenly for the business. Many makers, however, are working off old contracts faster than they are replacing them. As a result, corrugated sheets of 24-gauge have weakened to £14 2s. 6d. This price is quoted by the larger manufacturers, although small concerns have offered sheets at £14 5s., which is 2s. 6d. below last week's minimum.

Raw Iron Values.

The deflation in values of foundry pig iron continues. The buying induced by recent price cuts has not been of sufficient volume to restore complete solidarity to the trade. A little more interest has certainly been displayed in forward contracting, but actual buying is chiefly confined to proportionately small parcels for prompt delivery. Some small contracts for foundry iron have been placed by the light castings trade, which, though not uniformly brisk, is more active than the engineering industry. Some of the biggest ironfounders have not been absorbing raw material in anything like the quantities they were accustomed to, while so meagre is the volume of work at the forges that pig iron bought before the coal stoppage is not yet used up. Blast-furnacemen under these circumstances must either curtail production or lower prices to such a level as to induce forward buying. In one instance in this area a furnace has been "blown out," but the remainder continue to produce and accept the best price obtainable, hoping that a brisker demand will spring up in the autumn to recompense them for present sacrifices. Some Derbyshire houses which last week held out have now come into line, and prices are based on £3 7s. 6d. at furnaces for No. 3 for good-sized orders. Northamptonshire makers, on the other hand, were disposed to stiffen their quotations on the strength of the brisker demand which has sprung up since values went to £3 2s. 6d. Anything less than £3 3s. 6d. for No. 3 is now exceptional. Forge prices were tested, but very little business was done. Consumers expected to buy Northamptonshire forge at a figure well below £3. Derbyshire forge was hardly in evidence.

Blast-furnace Coke.

By reducing output the coke producers have recovered the initiative to some extent in the Midlands. Two or three weeks ago a number of the cokeries had such heavy accumulations of stock that they accepted prices as low as 12s. 6d. on rail to relieve the congestion. Many smelters took advantage of the offer, which soon closed, ovenmen considering it wiser to suspend part of their coke converting plant. Consequently the pendulum has now swung in the other direction, and sales of coke are now being made in the Midlands on the basis of 13s. to 14s. for good grades, such as are called for by smelters in the district.

Mining Subsidence and Compensation.

The recommendation to extend the right of compensation for damages through mining operations, whereby small property owners might be included, contained in the final report of the Royal Commission on Mining Subsidence is of special interest to the Black Country, where the wreckage of houses arising from the working of collieries has been enormous, and where the threat to property from subsidence continues to be very considerable. Colliery proprietors in this area regard the recommendation as not only impracticable, but one that would inflict an insupportable burden upon the mining industry of the Black Country. The majority of the mines in this area are to-day being worked on a very small margin of profit, and in some cases at an actual loss, and the proposals of the Commission would, it is asserted, be fraught with the most serious consequences to the industrial life of the community. A prominent Black Country mining engineer this week condemned the proposals as being absolutely unworkable. "The members of the Royal Commission in making them," he said, "have been actuated by purely sympathetic feelings for the small property owners without freehold rights who have been unfortunate to have their houses pulled about by mining operations. They seemed to have ignored the logic of facts, and some of their proposals are absolutely bereft not only of equity but of common sense." Colliery proprietors in this area point out that the mines largely make the prosperity of a district, and the people who come along to build and traffic over the surface know very well the risks they run, and take those risks to benefit by the prosperity derived from the mines. Except, therefore, in the case of property erected before the sinking of mines, there is much to be said for the view that mineowners should not be called upon to pay for risks knowingly taken by other people.

Prevention Better than Compensation.

A portion of the Royal Commission's report on Mining Subsidence, to which much attention has been given hereabouts, is that which deals with prevention of damage. It is suggested that the British Colliery Owners' Research Association should expedite its promised inquiry into the methods of working coal, with special reference to the mitigation of subsidence, and that local authorities might help by use of their powers under the Town Planning Acts, as well as by framing their by-laws to make them suitable to the district and by testing different special methods of construction. Prevention, after all, is better than compensation, and if by greater care beneath the surface and more suitable house construction above it, and by the avoidance of building at all over dangerous parts where possible, the risk of damage by subsidence can be reduced to a minimum, it will be the better way.

Local Authorities' Electricity Undertakings.

The results of the year's working of several of the Midland local authorities' electricity undertakings are now available, and they are of more than ordinary interest this year on account of the difficulties experienced owing to the coal strike, the unfavourable industrial conditions, and the high cost of fuel. The Wolverhampton Electricity Committee is able to report a successful year's working. The principal expenditure out of capital was in connection with feeder and distributing cables, totalling £60,077. The revenue amounted to £254,992, an increase of 22·5 per cent., and the gross profit was £107,731. After allowing for all calls there remains a net profit of £28,322. The Committee proposes to contribute £10,000 to the relief of the rates, and allocate £18,322 to reserve, making this fund £82,872. The units sold were over 53,500,000, a 20 per cent. increase. Working cost per unit sold remained as last year, viz., ·935d., though the coal strike sent actual works costs up by 13 per cent. The average selling price remained very low at 1·103d. per unit, and the number of consumers had increased by 2112, the total now being 10,253. The Coventry Electricity Undertaking is not in the same fortunate position, the year's working resulting in a loss of £16,631, but the balance of profit brought forward from previous year (£10,043) reduces the debit balance to £6588. The income of the Walsall electric supply undertaking during the year was £117,502, compared with £104,122 in the previous year, but the working expenses went up from £59,431 to £72,859. Fuel accounted for £10,793 of the increased cost. The gross profit of £44,643 was practically the same as in the previous year.

South African Contract for Birmingham.

It is understood in Birmingham this week that the South African Railway Board has accepted the tender of the Birmingham Railway Carriage and Wagon Company, Ltd., for three main line coaches, at £3111 each. There were twenty tenders, including several American and European firms, and that a Midland firm should have been successful gives considerable satisfaction to industrialists in this area generally.

Sanitary Engineers.

The Institution of Sanitary Engineers held its summer meeting last week in Birmingham, the two days over which it extended being largely spent in visiting public works in the city and district. The general meeting was held in the Council House on Friday, the President, Dr. C. S. Coleman, of Manchester, presiding over a small gathering. The report of the Council, which was adopted without discussion, showed that the membership of the Institute stood at 773—a net increase in the year of 37. Of fourteen candidates who presented themselves for examination during the year seven passed. The desirability of holding overseas examinations was, it was announced, still under consideration, and although some progress had been made in formulating a scheme, the complete programme had not yet been arranged. The Council continued, on suitable occasions, to make representations to authorities concerned in making public appointments with regard to the recognition of membership of the Institution as a qualification entitling members to apply for official sanitary engineering appointments that are open from time to time, especially as regards those in the Colonies and Overseas Dominions. Some recognition had already been obtained. Steps were being taken with the view of obtaining a Royal Charter of Incorporation, and some progress had been made in the preliminary stages necessary. During the afternoon the members visited the Corporation Sewage Disposal Works at Tyburn, and afterwards journeyed to Lichfield, where they inspected the Guildhall, the Cathedral, and the Johnson Memorial. They returned to Birmingham for dinner. Mr. H. H. Humphries, city surveyor and engineer, proposing the toast of the Institution of Sanitary Engineers, stated there was no doubt that sanitary engineering to-day was carried out in a scientific manner, and was responsible in no small degree for the good health of the community.

Unemployment.

Last week's decrease in Midland unemployment has been short-lived, for the latest official returns record an increase of 5151, the total having risen on the week from 133,885 to 139,036. The number of workers in the area on short time included in the above total increased from 60,215 to 63,528. In the Birmingham area there are roughly 2500 more unemployed this week, and at Coventry again roughly 720. In Wolverhampton the increase is nearly 200. Of the total unemployed no less than 102,008 are men.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Price Rings and Central Purchases.

PRICE rings in relation to municipal buying were referred to at a meeting of the Manchester City Council in the course of a discussion on the official list of approved contractors. Councillor J. Toole, as an illustration of how, he alleged, the existence of price rings defeated the objects of the Central Purchasing Committee of the Corporation, said that recently the Committee advertised for electric lamps. As a result, nine firms tendered for 70,000 lamps at a cost of approximately £10,000, and in the tenders there were 270 items which did not show a fractional variation in price. In support of the protest of the London County Council, the speaker asserted that there was no private enterprise in the electric lamp industry, and when the Central Purchasing Committee attempted to buy direct from the makers they were informed that they must buy from one of the twelve agents in Manchester, and distribute the order among them, so that each might get their 25 per cent. commission.

Salford's £150,000 Electricity Extension Scheme.

Salford City Council has approved of the proposal of the Electricity Committee for the extension of the Agecroft power station in order to meet the increasing demand for current. Details of the proposals, which will involve a capital expenditure of £150,000, were given in my letter last week. The chairman of the Electricity Committee, Alderman G. Billington, said that the estimated maximum demand and output for the year 1929–30 was 31,000-kW—76,000,000 units. These figures, which are based on a normal rate of increase, compare with 16,035 kW—33,730,000 units—in 1922–23. The Agecroft station was formally opened in September, 1925, and the buildings are capable of housing a fourth generating set, which, it is recommended, should be of 15,000 kW to 20,000 kW capacity. Mr. Billington said the expenditure on the Agecroft station at the present time was £727,110, which worked out at £19 4s. per kilowatt installed. The estimated cost of the proposed extensions worked out at £7 10s. per kilowatt, and would have the effect of reducing the total cost of the station to £15 2s. per kilowatt.

Local Contracts.

Among recent contracts placed with local engineering firms are an order for twelve locomotives of the "Garratt" type for the Buenos Aires Great Southern

Railway Company placed with Beyer, Peacock and Co., Ltd., Gorton, Manchester, and one for two Simon-Carves boilers, each with an evaporating capacity of 25,000 lb. of water an hour, placed by the Vale of Neath Colliery Company with Simon-Carves, Ltd., Manchester.

Non-ferrous Metals.

During the past week tin has continued at an accelerated rate the decline referred to in my last report, and it is a matter of interest to note that at its present price of £282 10s. for cash, metal values in this section of the market for non-ferrous metals are not much short of £20 a ton less than they were only a few weeks ago, when for a short spell the £300 mark was touched and passed. Naturally, this has been a severe check to the "bullish" interests who were relying upon the apparently strong statistical position of the metal to maintain prices. Both prompt and forward tin have been in free supply during the week, and this factor, combined with a sluggish inquiry, has had the result indicated above. Apart from a certain amount of buying of refined descriptions of copper for the cable-making industry, there has been only a moderate business passing in this section of the market. Values, however, have recovered a certain amount of strength and at the prices ruling at the time of writing are about on the same level as they were a fortnight ago. The demand for lead from the consuming industries is still on a restricted scale, but after a spell of weak and fluctuating prices quotations on balance finished up exactly where they were at the time of my last report. Inquiry for spelter has also been limited, but as offers of this metal have not been excessive, the market has shown a steadier feeling. Certainly, no fresh decline has taken place compared with a week ago.

Iron.

Contrary to expectations, a further shading of prices at which Derbyshire foundry iron has been on offer on the Manchester market has taken place during the past week, but if sellers were somewhat prematurely confident about a fortnight since regarding their ability to maintain quotations at the level then ruling, it seems reasonably safe now, at all events, to regard current values as being at or in the immediate neighbourhood of "rock bottom." Supplies of Derbyshire No. 3 foundry iron are now being offered here by the leading makers at 75s. 6d. per ton, delivered Manchester or equal. Actually, this price is only 6d. a ton more than it was fifteen months ago, before the general strike. If allowance be made for the higher cost of railway transport of the raw materials and the finished product current quotations are relatively cheaper than before. That users are more confident in the stability of the market may be inferred from the fact that a better business has been reported, with orders spread over a wider period. At the moment Staffordshire sellers on this market are maintaining their prices at 77s. 6d. delivered, but it is doubtful how long they will be able to do so in face of the cheaper Derbyshire article. There has been little change in the position of either Middlesbrough or Scottish, prices being held at 83s. and 95s. respectively. Hematite, however, has given way a little, quotations for delivery into this area being at about 90s. per ton. With regard to Lancashire bar iron, the demand for this remains on a very disappointing scale, and users are not disposed to place orders for any important quantities. Crown quality iron is quoted at £11 and seconds at £10 per ton.

Steel.

A quiet trade is being done in the steel market, but a big proportion of it is in respect of contracts still unexpired. For the remainder, it is largely a question of hand-to-mouth buying. Users feel that in the steel market, at any rate, there is still some room for further price concessions, and they are regulating their commitments accordingly. As before, sections are quoted at £7 12s. 6d., and ship plates at £8 7s. 6d., with boiler plates at about £11 5s. and steel bars rather weak at £7 17s. 6d. to £8 12s. 6d. Forging blooms are maintained at £9 10s. delivered, and special and ordinary acid wire billets at £12 10s. and £11 respectively. Trade in imported steel materials shows little indication of picking up. Whether the firmer tone that is now being displayed in connection with these products will serve to stimulate the demand is questionable. Equally uncertain is the question of how long sellers of continental steel will be able to sustain the higher prices they are now asking. Imported joists, for delivery to works in the Lancashire area for cash against documents, are being quoted at £5 15s., Siemens plates at £7 10s., ordinary plates at £7 5s., steel bars at £5 15s., billets at from £5 5s. to £5 7s. 6d., sheet bars at £5 7s. 6d., and wire rods at from £6 12s. 6d. to £6 15s. per ton. Galvanised sheets are attracting little attention from buyers, and prices are largely nominal at £14 5s. to £14 10s. per ton f.o.b., for the usual Bombay or Calcutta specifications.

Scrap.

A slight improvement in inquiry on the non-ferrous metal scrap market has been reported, but with many foundries on short time actual demand has not expanded to any appreciable extent. Heavy copper scrap is quoted at £59, brass rod turnings at £39, heavy yellow brass at £44, selected gunmetal scrap at £52, scrap zinc at £23, and scrap lead at £22 10s. for sorted qualities and including delivery to users' works.

BARROW-IN-FURNESS.

Hematites.

The position of the hematite pig iron trade of North Lancashire and Cumberland is not satisfactory. Business on general account continues to be slow, with only immediate wants being covered, and on overseas account there is little on offer. Barrow and Workington steel makers are taking pretty good deliveries of iron, but with it all there is more iron being produced than can be disposed of. The recent effort to bring in new business by lowering prices has had no effect, and no real change is anticipated at the moment. A change for the better may occur after the August holidays.

Iron Ore.

The demand for hematite iron ore is slow, being for the most part confined to local smelters with a limited trade in best grades to outside smelters. The importations of foreign ore are now easier.

Steel.

The steel trade remains pretty well employed. Rails are the chief output at both Barrow and Workington, but new business is very slow in coming to hand, either on home or overseas account. There is a steady call for hoops, on overseas account mostly, and the Barrow plant keeps busy. Steel castings are in fair demand.

Shipbuilding and Engineering.

Both these trades are well employed in most departments, but new shipbuilding orders are very difficult to secure.

Fuel.

The demand for coal and coke is easier.

SHEFFIELD.

(From our own Correspondent.)

Heavy Iron and Steel Trades.

WITH the usual July conditions prevailing, trade in the heavy iron and steel branches displays a tendency to drag, and except for minor adjustments from time to time nothing of a very marked nature can be expected until the autumn. Pig iron is cheaper again, having been dropping steadily since the slump in blast-furnace coke set in, but the total aggregate effect on the cost of steel production is not yet sufficient to warrant any drastic reduction. The question of steel prices has been under close consideration of late, but it is a very difficult one, and in their present position the makers have to proceed with great caution. No hasty step can be taken lest an artificial position should be created which might have very serious results in the long run. The lessons learned during the troublous post-war period have not been forgotten. The output of open-hearth steel is being maintained, though buying is none too free. Nevertheless, taking all circumstances into consideration, the position is one that justifies an optimistic view. Some of the makers of finished products are well booked up, and with a promising number of inquiries about, there should be brisker buying movement ere long.

Engineering Departments.

There are no outstanding features to note this week about the engineering trades. Work keeps on a fairly level plane, and though there is considerable room for improvement, conditions are steadier, and work is possibly a little more profitable. The heavy departments, it is true, do not show any signs of fully regaining the ground lost during the big slump that followed the war, but the reorganisation of departments and specialised production in other lines is now providing some compensation. For smaller castings and forgings there is a fairly steady business, and in spite of keen foreign competition important markets are well held. At the same time there is no gainsaying the influence that this competition is having on Sheffield trade in the home market, and instances are continually cropping up in which local engineering firms tendering for work in this country are being well undercut by continental makers. Railway work holds out more promise. Firms in this district are interested in several useful locomotive contracts that have been placed recently, and there is a fairly satisfactory output of tires, springs and buffers. This district, too, is interested in the announcement that the London and North-Eastern Railway Company has decided to construct 2100 wagons at a cost of £330,000. They include 12-ton open goods wagons and special bolster wagons for the conveyance of steel rails and long iron. Contracts for 1000 open goods wagons have been placed with private firms, including W. H. Davis and Co., Langwith Junction, and Rigley, Bulwell Forest, Nottingham. The remaining 1100 wagons will be built in the railway company's shops.

Large Cutlery Order.

An order has been received by Sheffield Steel Products, Ltd., Templeborough Works, Sheffield, for the supply of cutlery to the Director of Army Contracts, India. The order is for 86,000 pieces—30,000 knives, 32,000 forks and 24,000 spoons. These goods will be manufactured at the Templeborough Works, where the latest machinery has been installed to deal with orders for bulk quantities of cutlery, files and tools. It is anticipated that the whole of the order will be completed within two months.

Steel Trade Co-operation.

Several important speeches made in Sheffield recently have emphasised the necessity of co-operation among the steel manufacturers of this country in order effectively to meet foreign competition. The latest speaker to make this appeal is Mr. W. L. Hichens, chairman of Cammell Laird and Co., Ltd. Addressing a gathering of delegates to the annual Convention of the Institute of British Foundrymen, which was held in Sheffield last week, Mr. Hichens said that firms in this country were not really rivals one of the other; they were each more the rivals of the foreigners. What mattered for this country from the broad point of view was that its industry as a whole should be as efficient as possible, and that the weakest members should be helped by the stronger members, so that together they could be strong enough to stand up against foreign competition, and that by united knowledge and competition they would be able to face the strenuous opposition which they were meeting abroad to-day. Mr. Hichens suggested that they might allow each other freely to visit one another's works and might compare costs. It was the right thing to do if they were to have a nationally efficient industry.

Electrical Contracts.

Two interesting contracts have been placed with the Metropolitan-Vickers Electrical Company, Ltd., of Sheffield and Manchester. One is for the complete electrical equipment of a new airship, the R 100, which is being built at North Howden, Yorkshire, by the Airship Guarantee Company, Ltd. The electrical equipment is to provide a service for compartment and navigation lighting, compartment heating, cooking and water heating, and wireless signalling. A direct-current system has been adopted, and a special scheme has been worked out by the company to meet the unusual requirements, in which considerations for safety and minimum weight of apparatus are of paramount importance. In order to reduce weight to a minimum the whole system has been designed to utilise equipment of the smallest possible size and weight, combined with the highest possible efficiency. A careful study of the requirements has shown that the necessary services can be maintained by a 25-kW supply, and two generators of this total capacity are to be installed in the machinery cars, where they will be driven by the small petrol engines which are used for starting the main driving engines of the ship. Casings of apparatus and most of the fittings throughout the ship will be of light alloy, while for the wiring system a cable with conductor and armouring sheath, both of aluminium, will be used. The second important contract which has just been placed with the company covers the supply of all the outdoor and indoor switchgear required for the Perak River hydro-electric scheme in the Malay Peninsula. The switchgear to be supplied includes more than a hundred oil circuit breakers and about 700 isolating switches for 66,000, 22,000 and 6600 volts service, together with all the necessary constructional steel work for outdoor installation of this gear. The contract also includes the provision of the control board and switchgear for the station accessories for the main power station, and an eight-panel switchboard for 6600-volt metal-clad units for a stand-by steam power station which is included in the scheme.

Colliery Development.

The new colliery at Upton is developing rapidly, and coal is now being drawn to the surface and used for the boilers. The sump, 40 yards below the Barnsley seam, has been completed, and headings are being driven in the direction of the other shaft, where coal has not yet been reached. The London and North-Eastern Railway Company is making preparations to provide better facilities for Upton, as the present siding accommodation is altogether inadequate for the needs of the colliery. Houses for the miners are also being built at great speed.

Roadmaking Demonstration.

A demonstration of roadmaking on a new principle took place near Gainsborough, on a stretch of the old-fashioned kind of stone road. Without turning up the road three workmen, without machinery, re-laid 20 to 30 yards in less than half an hour. Large slag taken from the Scunthorpe mines was used as a foundation, smaller slag was placed on top and a new kind of emulsion fastened the bed in a few minutes. The product used was taken direct from the barrels and sprayed over the slag, and a fine surface, similar to tar-macadam, was placed over the heavier stones. The emulsion was applied cold, and became hard very quickly. The cost of making the road, including the tar, gravel, slag and sand was 3s. 2d. per square yard.

NORTH OF ENGLAND.

(From our own Correspondent.)

Trade Slump.

THE little post-dispute boom in the iron trade, which everyone hoped heralded a return to conditions of normal prosperity, has already worked itself out, and ironmasters are becoming very anxious as to the future. The industry received another set-back this week by the decision of Bolckow, Vaughan and Co., Ltd., to stop two furnaces engaged upon the production of Cleveland pig iron. Some weeks ago the firm had contemplated the blowing out of the two furnaces, but was able to postpone the evil day as a result of good orders received. The stoppage will reduce the number of furnaces in operation on the North-East Coast to 40, as compared with 38 before the coal dispute.

Cleveland Iron Market.

The Cleveland pig iron market position is very discouraging. Business continues exceedingly dull, and there is a growing feeling that, when customers are compelled to negotiate for supplies to cover autumn requirements, they are likely to continue to confine their transactions to purchases for early delivery. Buyers hold that prices are too high, and producers reiterate that costs of output prohibit a further fall in quotations. Profit undoubtedly is very small, and some commodities are being manufactured at a loss. Fear is expressed that, unless buyers come forward fairly freely with orders for their autumn needs, more plant will have to be put out of action. Reports of a firmer feeling in continental commercial circles inspire hope that foreign competition may be lessened to some extent, but pig iron from abroad is still selling at a price considerably below the rate for Cleveland iron. No. 1 Cleveland foundry iron is 72s. 6d.; No. 3 G.M.B., 70s.; No. 4 foundry, 69s.; and No. 4 forge, 68s. 6d. per ton.

Hematite Pig Iron.

Producers of East Coast hematite are very keen to liquidate their rather heavy stocks, but with the present small output not quite sufficient to meet current needs, the situation in this branch is healthier, and buyers experience some difficulty in breaking the recognised market rates. Mixed numbers are quoted from 76s. 6d. to 77s.

per ton, with a premium of 6d. for No. 1 quality. Recent sales include small parcels for the Sheffield district, for South Wales, and for various continental consuming centres.

Ironmaking Materials.

The foreign ore trade is idle, consumers having large stocks. Best Rubio ore is nominal at 21s. 6d. per ton c.i.f. Tees. Sellers of Durham blast-furnace coke appear unable to check the downward movement. Good medium qualities are now obtainable at 20s. per ton delivered at the works.

Manufactured Iron and Steel.

Producers of finished iron and steel are still fairly well off as regards orders, but new business matures very slowly. The stiffening of steel quotations on the Continent is attributed to speculative buying by merchants who believe that values have touched bottom. The movement has slightly stimulated this market and has inspired hope of some expansion of business, particularly as customers abroad appear to be taking a little more interest in the position here. The orders for six new ships just placed on the Wear should give a slight impetus to the steel trade, and another gratifying feature is the increased demand for galvanised sheets from abroad, some large orders having been placed. Prices are unaltered.

The Coal Trade.

There is no sign of the long-expected improvement in the Northern coal trade. When the pits resumed work last December after the general stoppage, there were hopes of at least three months good demand for coal. They were not realised, and ever since the outlook has been gloomy and uncertain. It is no better now, and none can point to any region and say that it will be from that direction that a revival in business may be expected. The position is as full of perplexities as ever. There is a moderate amount of prompt business being done, and this is in favour of shippers, especially to the Mediterranean, as coal prices can be shaded and freights are low. On the other hand, the Baltic has a more active appearance, as there is some outward demand, and there is a considerable amount of timber to be shipped homeward. Generally speaking, however, the coal situation is weak, and although the gradual closing of collieries is reducing output, the supplies are still greater than the market can absorb, and prices do not display any tendency to a firmer tone. The position in the Northumberland steam coal section is very disappointing, and fitters in every section have mainly to depend on old contracts to keep the pits working. With no competition from buyers, fitters and second-hands have to compete keenly for available business, and in some cases prices can be discounted. Best Northumberland steams are in the neighbourhood of 14s. 3d., with smalls at 10s. 6d. Best Durham steams, large, are easy at 16s., and smalls, at 12s. Durham gas coals remain a very slow trade. Best qualities are quoted at 16s. to 16s. 6d., and secondary kinds at 13s. 6d. to 14s. Unscreened bunkers keep to a steady trade, but under ample supplies good descriptions offer at 14s., and best or specials 14s. 6d. to 15s. A quiet demand is experienced for gas coke, but the daily production is readily cleared away at steady prices, based on 19s. to 19s. 6d. for shipment. Foundry cokes show no improvement. The output is in excess of requirements, and prices are unchanged, good patent makes at 18s. to 19s.; specials, 25s. to 26s.; beehive coke, 28s. to 32s.

Shipbuilding Revival.

The placing of orders for six new vessels with Wear shipbuilders has revived interest in the shipbuilding trade on the North-East Coast. Inquiries are beginning to circulate more freely for new cargo steamers. Up to the present, the yards have been engaged principally on the construction of oil tankers, motor ships and vessels for special trades, but now a slight demand is experienced for ordinary tramp tonnage, which seems to indicate that owners are getting rid of their older boats and are replacing them with vessels of the most up-to-date kind. It is hoped that a good deal of this type of tonnage will be placed, as new contracts will be wanted soon, so rapid has production been of late.

Cleveland Miners' Wages Reduced.

Cleveland miners' wages are to be reduced by 5 per cent., as from July 25th. The decline in pig iron prices is responsible, the ascertained price for the last completed quarter being lower by 3s. 7·7d. per ton. The men's wages at present are 69·3 per cent. above the standard.

SCOTLAND.

(From our own Correspondent.)

Diminishing Trade.

In practically all branches of the steel and iron trades the demand is lessening, and few works are fully employed. Specifications for most classes of material are becoming more scarce, and the outlook is most unsatisfactory. In most, if not all, cases the annual holidays, commencing this week, may extend to at least two weeks, instead of the customary ten days. It is hoped that conditions will improve after the holiday season, but the presence of cheaper foreign materials in the market is a source of anxiety, as many consumers who may refrain from purchasing abroad are only buying from hand to mouth in the hope of a fall in home prices. It has been said that there are indications of an improvement in trade which may be apparent in the early autumn, but meantime it is difficult to trace the source of any such happening.

Steel and Iron.

In the steel and iron trades there has been a gradual slowing down in view of the holidays, a proceeding entirely the reverse of the usual happenings in busy times. New business is very slow, while specifications against existing contracts are also slow to materialise. The demand for plates and sections has been reduced to a minimum, and it is said that quantities bought on a speculative basis some months ago have not yet been fully taken up. Makers of bar iron and steel re-rollers are working from hand to mouth, and outputs as a rule are more than sufficient to meet all requirements. The home price of re-rolled steel bars is unchanged at £8 2s. 6d. per ton, but the export quotation is receding, and is now approximately £7 12s. 6d. per ton.

Steel Sheets.

Makers of the cheaper qualities of black sheets, and particularly the heavier gauges, have struck a quiet patch, but the better qualities of black and galvanised sheets are well placed, and in some instances fully booked up for some weeks ahead. Prices are unchanged.

Pig Iron.

The output of hematite and foundry pig iron, meagre though it is, more than accounts for all demands, and the tone of the market continues to weaken. Keen competition is experienced from English sources as well as from the Continent.

Coal.

The firmness of washed fuels and nuts in particular, remains the feature of the Scottish coal market. All small stuffs are scarce, and big prices are being paid for small lots. The home and export demands for large fuels are feeble, and only Lanarkshire splints maintain a firm front. Aggregate shipments amounted to 265,890 tons, against 241,597 tons in the preceding week and 260,153 tons in the same week in 1925.

Miners' Wages.

The Lanarkshire Miners' Union delegate conference has decided to instruct its delegates to the Scottish miners' national conference to vote in favour of accepting the proposed new wages agreements, Clause 12. Objection was taken to this clause, owing to the fact that it enabled the owners to make separate agreements with the Colliery Enginemen and Underground Firemen's Association. It was suggested that the owners should submit the clause to arbitration, but that suggestion was declined by the owners, who insisted that Clause 12 must be accepted as a condition of signing the agreement. The Miners' Executive then referred the question to the districts to ascertain their opinion prior to the holding of the annual conference, and it is understood that the Lanarkshire decision is regarded as an indication of acceptance of the agreement.

Locomotive Works Busy.

Employment at the North British Locomotive Works, Springburn, has been very regular of late, and the same can be said of the London and North-Eastern Railway Company's works at Cowlairs, and also of the London, Midland and Scottish Railway Company's establishment at St. Rollox. The first-named has orders on hand for the Sudan Government Railway, and the London, Midland and Scottish Railway, while the St. Rollox works are busy with repairs, rebuilding, and also the construction of new engines and tenders for passenger and goods traffic.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

There has not been much, if any, change in the conditions prevailing in the steam coal trade as compared with a week ago. The tone is quiet, and there is a shortage of prompt orders, with the result that by far the majority of the collieries are working irregularly. There were thirty-three idle loading appliances at the various docks at the end of last week, and the position on Monday, after allowing for the arrival of tonnage, was not much improved, as the number of idle appliances was only reduced to twenty-six. From this fact it is, of course, very evident that loading operations are far below normal, and that the failure to be able to ship quickly means that there are large stocks of coal standing. Still, shipments from South Wales last week were a shade better than they were the previous week, as the total amounted to 463,573 tons, as against 452,895 tons. So far as the market is concerned, prices are not materially lower, but they are very uneven. Now business is not coming in quick enough to afford hope of any immediate improvement. At the same time, there are a few inquiries on the market, the most important of which is one from the Egyptian State Railways for 125,000 metric tons of locomotive coals for delivery over the three months ending November next at Alexandria. Tenders have to be submitted at Cairo for adjudication on August 23rd, so that plenty of notice has been given of the business. The Buenos Aires Great Southern Railway is also inquiring for prices for 36,000 tons of locomotive coals over the next three months. Prices have to be sent in at once. It is also reported that the Central Brazilian Railways have placed a contract for 50,000 tons, consisting of two-thirds large and one-third smalls, with one of the collieries producing the best Admiralty coals, the delivery being over three months ending September. Shipments to France appear to be slightly less active, but it is interesting to note that information has come to hand that under the French coal decree monthly licences will be valid for ninety days, so that quantities not delivered in one particular month can be shipped in the succeeding month, which virtually means an extension of contracts.

Coalfield Items.

Reference was made last week to the trouble which occurred in the Maesteg district on account of the non-unionist campaign which was organised. The pits were rendered idle on the Tuesday, but within about twenty-four hours the stoppage was called off and the men were ready to go back to work, but the management was not in a position to allow a resumption to take place. The action of the men resulted immediately in business going to other collieries where there was no non-unionist trouble, with the consequence the men had to pay the penalty of staying out longer than they desired. Even some of their leaders, who should know better, appear to think that they can call a stop one minute and then call for work again just as it suits them. Unfortunately, notices continue to be served upon the miners at individual pits in various areas, and in the case of many of them there is very little doubt that at the termination of the fourteen days work will cease, as there is no real sign of the lifting of the present depression.

LATER.

After they had been idle for a week, work was resumed at North's Navigation Collieries in the Maesteg area on Wednesday night.

Shipping Facilities.

Speaking at the annual summer meeting of the South Wales branch of the Institution of Mechanical Engineers, held at Cardiff last week, Sir Henry Fowler, the President of the Institution, paid a high tribute to the coal shipping facilities at Cardiff. He said that he had seen something of what the Great Western Railway Company was doing at Cardiff to win the peace. He had seen much of the coaling plant in the United States, and particularly the famous appliances handling coal and ores at Cleveland, and the only thing in which the American plants seemed to beat the Cardiff equipment was in the size of the wagons. They were not dealing with the wagons in America any quicker than he had seen the wagons handled at Cardiff that—Thursday—morning. They had seen in that plant and in the new hydro-electric plant at the docks something that they could not have seen elsewhere in the country, for the Cardiff hydro-electric plant was pioneering the road in that direction.

Current Business.

There is without doubt a little more inquiry on the market, but it is not sufficient to have any perceptible effect upon values, which are as uneven as ever. The conditions are, without doubt, still very bad, but most people in the trade have come to the conclusion that they are now at about the worst, so that any alteration can only be for the better. Certainly there is no best Admiralty large coal which is quoted above 20s. 6d., and even superior second qualities are obtainable without difficulty at round about 19s. to 19s. 6d. per ton. Small coals just about maintain their position at 13s. to 14s., owing to the fact that the curtailed working at the pits is restricting the output. Coke is quiet, and there is no marked improvement in the demand for patent fuel. Pitwood is quoted at 26s. to 27s.

VOLTA CENTENNIAL CELEBRATIONS.

During the year 1927 a series of congresses and exhibitions will be held in the town of Como, in order to celebrate the centenary of Alessandro Volta. National and international congresses of both pure and applied science are announced. The programme also includes an exhibition of Italian industries, mechanical, chemical, and electrical, as well as international telegraphic and telephonic competitions. A specially notable feature will be the International Congress of Physicists, which is to be held from September 14th to 16th. Invitations to attend this Congress have been issued to leading scientists throughout the world, and, as at present arranged, papers will be presented by a total of no less than sixty-eight distinguished men from the following different countries.—Austria, Canada, Denmark, France, Germany, Great Britain, Holland, India, Italy, Russia, Spain, Sweden, Switzerland, and the United States.

The representatives from this country will include Dr. F. W. Aston, F.R.S., of the Cavendish Laboratory, University of Cambridge; Professor W. L. Bragg, F.R.S., Langworthy Professor of Physics, Victoria University of Manchester; Dr. A. S. Eddington, F.R.S., Plumian Professor of Astronomy, Cambridge University; Dr. J. A. Fleming, F.R.S., who, amongst many other things, is Professor of Electrical Engineering in the University of London; Dr. O. W. Richardson, F.R.S., Yarrow Research Professor of the Royal Society; Sir Ernest Rutherford, O.M., F.R.S., Cavendish Professor of Experimental Physics, and Director of the Cavendish Laboratory, University of Cambridge, and Professor of Natural Philosophy, Royal Institution; and last, but not least, Sir J. J. Thomson, O.M., Past-President of the Royal Society, who, besides being Master of Trinity College, Cambridge, is also hon. Professor of Physics at Cambridge and at the Royal Institution.

PAINTS, VARNISHES AND PAINT INGREDIENTS.

The British Engineering Standards Association has just issued new British standard specifications for blanc fixe, lead chromes, Prussian blue, carbon black, bone black, vegetable black, lamp black, and mineral black. They contain clauses regulating the composition, together with standard reception tests, for the purchase of these materials, together with appendices giving methods of carrying out the tests. These specifications have been prepared at the request of the paint manufacturers by a committee representative of both the buying and manufacturing interests, and as in the case of all British standard specifications, they will be reviewed as experience of their working or progress in the industry renders it necessary, and revised issues will be published from time to time. Copies of these eight new specifications—Nos. 281–288—can be obtained from the B.E.S.A. publications department, 28, Victoria-street, London, S.W. 1, price 2s. 2d. each post free. Amongst the specifications that have already been issued are those for ready mixed linseed oil paint (oil gloss) zinc oxide (No. 277), and ready mixed linseed oil paint (oil gloss) tinted paints (zinc oxide base) (No. 278).

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	4 2 6	
No. 1 Foundry	4 4 0	—
No. 3 Foundry	3 19 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 16 6	3 16 6
No. 1	3 17 0	3 17 0
Cleveland—		
No. 1	3 12 6	3 12 6
Silicious Iron	3 12 6	3 12 6
No. 3 G.M.B.	3 10 0	3 10 0
No. 4 Foundry	3 9 0	3 9 0
No. 4 Forge	3 8 6	3 8 6
Mottled	3 8 0	3 8 0
White	3 8 0	3 8 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 12 6	—
,, ,, Foundry	4 1 6	—
(3) Northampton—		
Foundry No. 3	3 3 6 to 3 5 0	
Forge	3 0 0	—
(3) Derbyshire—		
No. 3 Foundry	3 7 6	—
Forge	3 5 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 12 6	—
No. 4 Forge	3 10 0	—
Basic	3 10 0	—
(4) N.W. COAST— N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 9 6 (a); 4 12 6 (b); 4 15 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 15 0	10 10 0
Best	—	—
N.E. COAST—		
Iron Rivets	12 5 0	—
Common Bars	11 5 0	—
Best Bars	12 5 0	—
LANCS.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
MIDLANDS—		
Crown Bars	10 10 0 to 10 15 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 10 0 0	
Gas Tube Strip	11 17 6 to 12 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ¼in. and up	8 2 6	7 12 6
Sections	7 12 6 to 7 15 0	7 2 6
Steel Sheets, under 5/16 in. to ¼in.	10 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	—	£15 0 0 to 16 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 10 0	—
Light Rails	8 15 0 to 9 0 0	
Billets	8 0 0 to 11 10 0	
MANCHESTER—		
Bars (Round)	8 12 6	—
,, (Small Round)	7 17 6	—
Hoops (Baling)	11 0 0	11 0 0
,, (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
,, (Lancs. Boiler)	11 5 0	—
SHEFFIELD—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 to 8 2 6	
Intermediate Basic	7 10 0	—
Soft Basic	7 5 0	—
Hoops	11 10 0	—
Soft Wire Rods	9 5 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 10 0 to 6 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 2 6 to 14 10 0	
Angles	7 12 6	—
Joists	7 12 6	—
Toes	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	18/6 to 18/9
Block Tin (cash)	282 10 0
,, (three months)	278 15 0
Copper (cash)	53 13 9
,, (three months)	54 5 0
Spanish Lead (cash)	22 18 9
,, (three months)	23 7 6
Spelter (cash)	28 0 0
,, (three months)	27 15 0
MANCHESTER—	
Copper, Best Selected Ingots	58 15 0
,, Electrolytic	60 7 6
,, Strong Sheets	84 0 0
,, Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price) lb.	0 0 11½
,, Condenser lb.	0 1 1½
Lead, English	24 7 6
,, Foreign	23 5 0
Spelter	27 15 0
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/9½ per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
,, ,, 6 p.c. to 8 p.c. ,,	£22 15 0	7/3
,, ,, 8 p.c. to 10 p.c. ,,	£22 7 6	6/6
,, ,, Specially Refined		
,, ,,Max. 2 p.c. carbon	£36 5 0	11/6
,, ,, ,, 1 p.c. ,,	£42 5 0	15/-
,, ,, ,, 0.70 p.c. carbon	£54 0 0	17/6
,, ,, ,, carbon free	1/5d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£12 10 0 for home, £16 for export	
,, Silicon, 45 p.c. to 50 p.c. unit	£12 5 0 scale 5/- per	
,, ,, 75 p.c. unit	£19 5 0 scale 6/- per	
,, Vanadium	14/3 per lb.	
,, Molybdenum	5/- per lb.	
,, Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/6
,, ,, Ell	14/-
,, ,, Splint	15/3 to 17/6
,, ,, Trebles	16/6 to 17/-
,, ,, Doubles	16/- to 16/6
,, ,, Singles	13/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/-
,, ,, Jewel	15/6
,, ,, Trebles	16/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	11/9 to 13/9
Screened Navigation	18/- to 19/-
Trebles	16/6 to 17/-
Doubles	15 6 to 16/-
Singles	13/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	12/9 to 13/-
Secondary Steam	12/3
Trebles	16/3 to 16/6
Doubles	15/- to 15/6
Singles	13/6

ENGLAND.

(8) N.W. COAST—	
Steams	22/6
Household	42/6 to 58/6
Coke	24/6 to 25/-
NORTHUMBERLAND—	
Best Steams	14/6
Second Steams	13/- to 13/6
Steam Smalls	10/6
Unscreened	13/- to 13/6
Household	21/- to 27/-
DURHAM—	
Best Gas	16/- to 16/6
Second	14/- to 14/6
Household	21/- to 27/-
Foundry Coke	19/- to 26/-

SHEFFIELD—	Inland.	
Best Hand-picked Branch	27/6 to 28/6	—
Best Selected House Coal	21/- to 22/6	—
Screened House Coal	19/- to 21/-	—
,, ,, Nuts	16/- to 17/6	—
Yorkshire Hards	16/- to 17/-	—
Derbyshire Hards	16/- to 17/-	—
Rough Slacks	10/6 to 11/6	—
Nutty Slacks	8/- to 9/-	—
Smalls	3/- to 5/6	—
Blast-furnace Coke (Inland)	22/- *	—
,, ,, (Export)	f.o.b.	18/6 to 20/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	20/- to 20/6
Second ,, ,,	19/- to 20/-
Best Dry Large	19/- to 19/6
Ordinary Dry Large	18/6 to 19/-
Best Black Vein Large	18/6 to 19/-
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/6 to 18/-
Ordinary ,, ,,	17/- to 17/6
Best Steam Smalls	13/- to 14/-
Ordinary Smalls	12/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	20/6 to 21/-
,, ,, Smalls	16/- to 16/6
No. 2 ,, Large	17/- to 17/6
,, ,, Through	15/6 to 16/-
,, ,, Smalls	13/- to 13/6
Foundry Coke (export)	40/- to 42/6
Furnace Coke (export)	30/- to 32/6
Patent Fuel	23/6 to 24/6
Pitwood (ex ship)	27/- to 28/-
SWANSEA—	
Anthracite Coals	
Best Big Vein Large	38/- to 42/
Seconds	29/- to 33/-
Red Vein	25/- to 30/-
Machine-made Cobbles	45/- to 47/-
Nuts	40/- to 45/-
Beans	30/- to 35/-
Peas	19/- to 21/-
Breaker Duff	8/- to 8/6
Rubbly Culm	8/9 to 9/3
Steam Coals :	
Large	19/- to 20/-
Seconds	18/- to 19/-
Smalls	10/- to 11/-
Cargo Through	16/- to 17/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayreshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. * Official quotation for pig iron producers.

French Engineering Notes.

(From our Correspondent in Paris.)

The Steel Cartel.

THERE have been rumours to the effect that German steelmakers are prepared to take advantage of the clause in the Steel Cartel agreement whereby it may be allowed to lapse in the event of the French Government failing to pass the Tariff Bill within the stipulated period. The temporary commercial agreement between the two countries has, however, been prolonged for another month, and it is hoped to arrange for an extension until the end of the year. Although German steelmakers are by no means satisfied with the working of the Cartel under present conditions, seeing that they have rendered themselves liable to the payment of heavy fines for exceeding the production allotted to them in order to meet the home demand, they are not disposed to withdraw from the Cartel until they see the outcome of the negotiations for the constitution of international *comptoirs* for the sale of steel products. This is, indeed, regarded as a necessary part of the Steel Cartel organisation, and may eventually supersede it.

Locomotive Builders.

The Chambre Syndicale de Fabricants de Matériel de Chemins de Fer is complaining of the position in which locomotive and wagon builders find themselves by reason of the small number of orders that have been distributed during the past few years. Between 1904 and 1914 the capacity of locomotive builders increased by 100 per cent. and of wagon builders by 50 per cent. In both cases the capacity was again doubled between 1914 and 1923, and the shops attained their maximum production capacity at a time when the demand for rolling stock fell off considerably. The American material left in France after the Armistice, and the huge quantities of German locomotives and wagons that were surrendered on account of reparations, would have glutted the railways had they all been suitable, but quite a large proportion of the rolling stock was soon out of service, and the railway companies were obliged to restrict the purchase of locomotives and wagons at home on account of the financial situation. It is declared that during the past three years the orders placed only represented about 20 per cent. of the total capacity of the locomotive shops and 15 per cent. of the wagon works. The last few months, however, have seen a considerable accession of orders, to the extent that both locomotive and wagon builders are now well employed. The Chambre Syndicale is, nevertheless, claiming further protection, and is hoping to obtain under the new Tariff Bill a protective duty of 15 per cent. of the value of the railway material imported.

Aviation.

The three successful flights from New York to Europe have left an unsatisfactory feeling amongst the French that their aviation has failed to keep pace with air progress in other countries, and that it runs the risk of losing its former high reputation through lack of organisation and financial aid. Since the suppression of the Under-Secretary of State for Aeronautics, the air services have been attached to various departments, notably the army and navy, and there is no central organisation to co-ordinate effort and develop the services commercially and technically. There are credits which enable the Government to provide funds for any special work, such as the building of machines for breaking records or for particular services, but it is affirmed that these funds are far from sufficient to enable the air services to demonstrate their equality with those of other countries. In view of these obvious shortcomings, the Government is preparing plans for the creation of an Air Ministry which will probably take both the naval and military air services under its control. Public opinion is solidly in favour of this step, if only it will have the effect of providing the money necessary for developing the aeroplane industry along broader lines than have been followed in the past. The success of the Fokker type of aeroplane in the Trans-atlantic flights will, it is feared, have a very serious effect upon the French aeroplane industry, which depends to a large extent for its activity upon foreign orders for machines, and already French experts are insisting upon the necessity of evolving new types of machines of more commercial value than those which are built to military specifications. For some time past a new Farman machine has been ready for a flight from Paris to New York, but there is a possibility of its being forestalled by another Fokker aeroplane or by the machine which was piloted over by Chamberlin and will attempt to carry Mr. Levine back to New York with another pilot.

Greater Paris.

The sudden increase in the population of Paris after the war and the necessity of extending the city beyond the girdle formed by the fortifications now being levelled down, to say nothing of the water supply and disposal of sewage, have raised problems of a particularly serious character. On account of the erratic and unsatisfactory character of suburban building, the Municipal Council is endeavouring to lay down a definite programme of city extension, which it has been decided to carry out in circular zones. There will first be an open zone for gardens and playing grounds, then a zone of residential houses, the height of which will be restricted, followed by a zone of cheaper houses for the working classes, and then an industrial zone. Another urgent need is the sewage disposal, which is causing considerable anxiety to the Municipal Council, owing to the refusal of the suburban areas to accept any more sewage. It has been the intention to send the surplus sewage to a belt of land along the left bank of the Seine in the picturesque valley between Corneilles and Herblay. On that belt is the Achères sewage farm, which was laid out in 1882, and it is now proposed to extend it in both directions over a total distance of 10 miles, while at La Frette a pumping plant will be installed to distribute the sewage over this considerable area. All along the valley the towns and communes are, however, up in arms against the scheme.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

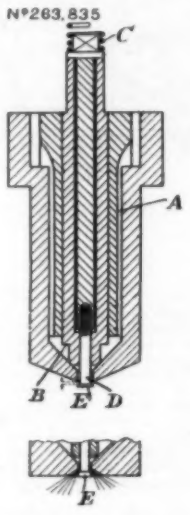
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

263,835. December 28th, 1926.—IMPROVEMENTS IN SPRAY PRODUCERS, Angelo Scheublein, of 14, Hippmannstrasse, Munich, Germany.

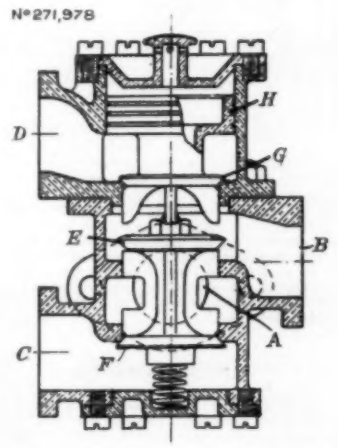
In the spray producer described in this specification the liquid is forced through the grooves A, and, when the pressure on the shoulder B is sufficient to overcome the pressure of the spring C,



the valve opens and discharges liquid around the needle D, through the nozzle, the liquid being baffled by the head E and subjected to intense atomisation. The lifting of the valve brings the head E so that the passage will be throttled in proportion to the pressure, while the atomisation of the liquid is enhanced. As soon as the pressure is relieved the spring C re-closes the valve.—*May 19th*, 1927.

271,978. March 14th, 1926.—SUPERCHARGERS, F. W. Berk, 95, Station-parade, Harrogate.

The inventor points out that if a supercharger is arranged between the carburetter and the engine, petrol is liable to accumulate in it, when it is not in service, and this petrol will flood the engine when the supercharger is started again. For this reason he uses the valve shown between the carburetter and the

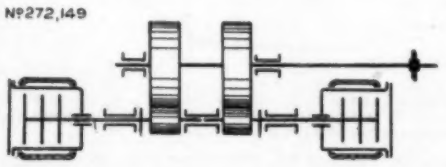


engine. It is connected with the carburetter at A, with the engine at B, with the suction side of the supercharger at C, and with the discharge from the supercharger at D. When the supercharger is inoperative, the suction of the engine lifts the valve E and closes the connection to the supercharger by means of the valve F. When the supercharger is working, it sucks open the valve F, closes the valve E and opens the valve G by the pressure under the piston H.—*June 9th*, 1927.

TURBINE MACHINERY.

272,149. April 4th, 1927.—STEAM TURBINES, *J. E. Pollak*, 20, *Holborn, London, E.C.* 1.

In this specification claim is made for "A high-pressure and high-temperature steam turbine unit comprising two turbine

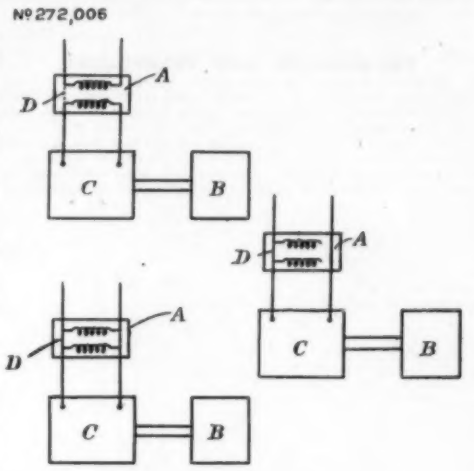


casings housing overhung rotors mounted on separate shafts which are geared with a common main shaft and are arranged to bear axially one on the other without a coupling." In this way the end thrust on the spindles is balanced.—*June 9th*, 1927.

DYNAMOS AND MOTORS.

272,006. April 22nd, 1926.—IMPROVEMENTS RELATING TO THE STARTING OF SYNCHRONOUS DYNAMO-ELECTRIC MACHINES, Henry Ormsby Burge and Robert Arthur Lochner, and Crompton and Co., Ltd., all of Arc Works, Chelmsford.

In accordance with this invention a synchronous machine is brought into synchronism with other synchronous machines by connecting the incoming machine to the external circuit through a synchronising transformer A, which is designed with a high impedance. The synchronous machine is run up to approximately the synchronous speed by mechanical power, derived, say, from a motor B, or from the direct-current supply, in the case of a rotary converter. After the field has been excited, the primaries of the synchronising transformer are

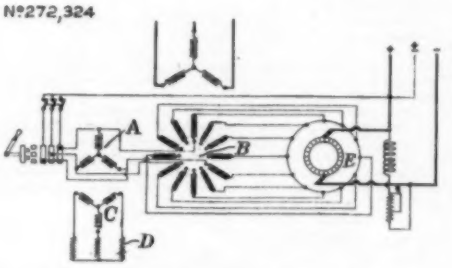


connected to the external circuits, and the secondaries to the terminals of the synchronous machine C, or to the slip rings in the case of a rotary converter. A current will then flow between the transformer A and the synchronous machine C, which will automatically pull into synchronism. When direct connection has been made with the external circuits—as shown in the lower diagram—the supply of current to the synchronising transformer may be interrupted, as shown in the right-hand diagram. The lead D may, however, be left permanently connected between the transformer windings without altering the operation of the synchronising transformer. There are two other diagrams, showing the complete connections for starting a six-phase rotary converter and a three-phase motor generator.—*June 9th*, 1927.

TRANSFORMERS AND CONVERTERS.

272,324. April 28th, 1926.—IMPROVEMENTS IN OR RELATING TO ELECTRIC MOTOR CONVERTERS, The Brush Electrical Engineering Company, Ltd., and John Humphrey Russell Nixon, both of Falcon Works, Loughborough.

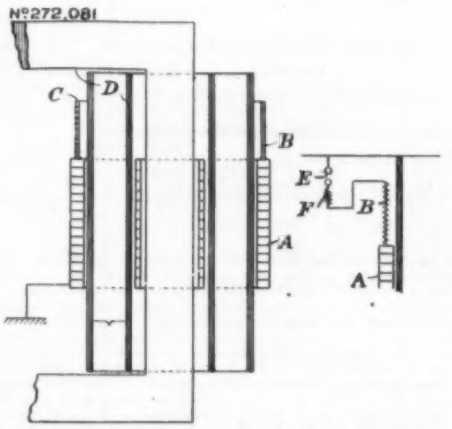
The main connections of a motor converter built in accordance with this invention are arranged as usual, and are shown on the right-hand side of the diagram. According to the invention, the rotor A of an induction motor is mounted on the shaft and is



connected in cascade with the rotor windings B. The secondary windings of the induction motor are shown at C, and they are connected in circuit with a starting resistance D. By means of this arrangement the converter may be accelerated to its normal speed, at which it will be maintained in synchronism by the direct-current part of the machine. For normal running the induction machine alternating current may be short circuited or disconnected in any appropriate manner.—*June 16th*, 1927.

272,081. October 13th, 1926.—IMPROVEMENTS RELATING TO HIGH-TENSION ELECTRIC TRANSFORMERS AND THE LIKE, *Arthur Vaughan Tomlinson, of* 65, *Victoria-street, Westminster, London, S.W.* 1.

While the stress in the field between the cylindrical windings



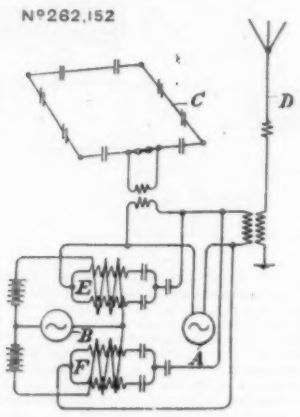
of transformers can easily be controlled, the substantially higher stress at the edge of the high-tension end of the cylindrical high-tension winding offers considerable difficulty, especially in

the case of very high tensions. The object of this invention is to obviate this disadvantage by decreasing the tension occurring at the edge of the high-tension winding. For this purpose the usual high-tension winding A is provided with at least one additional stabilising winding B, which is wound, so that its terminal end has a smaller difference of potential from the body of the apparatus than the main winding. The length of the stabilising winding and the voltage generated by it must be such that the resultant tension between the end of the earth pole C of the stabilising winding and the opposite pole at D—formed by the core and insulation—is less than that corresponding to the highest permissible edge tension. In order to obtain complete security, this should not be greater than the electrostatic field tension permitted in the concentric part of the winding. At the end of the stabilising winding a spark gap E may be provided between the winding and core or earthed part of the apparatus, so as to discharge any excessive tension, and a damping resistance may also be provided as shown at F.—*June 9th*, 1927.

TELEGRAPHS AND TELEPHONES.

262,152. November 30th, 1926.—IMPROVEMENTS IN RADIO SIGNALLING SYSTEMS. *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

The system of radio communication to which this invention relates is that in which the emitted high-frequency carrier wave is varied so as to make the emitted signals more easily received, and the invention is particularly concerned with the elimination

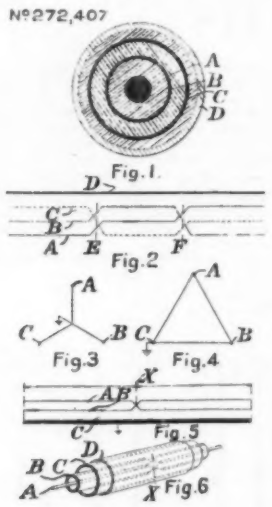


of faulty reception in cases in which fading is experienced. The plane of polarisation of the emitted waves is continually varied at a predetermined frequency. Current supplied from the high and low frequency sources A and B, is alternately radiated from the aerials D and C, which, as shown, are of different types. Modulating devices E and F connected in shunt with the aerials alternately transmit current to these aerials.—*May 26th*, 1927.

TRANSMISSION OF POWER.

272,407. January 18th, 1927.—IMPROVEMENTS IN AND RELATING TO CONCENTRIC CABLES FOR ALTERNATING CURRENTS, Charles Vernier, M.I.E.E., of 59, Church-road, Gosforth, Newcastle-on-Tyne.

According to this invention, in triple concentric cables for the transmission of alternating currents of high and very high voltage, the resistances, inductances and capacities of the several conductors are made equal or approximately equal by balancing. When the cable is used in connection with a star-connected three-phase system with the neutral point earthed, as shown in Fig. 3, the three conductors are balanced by arranging by means of cross-over joints that each phase shall comprise equal lengths of inner, middle and outer conductors between the terminal points. This may be effected by placing these joints at one-third, two-thirds and the whole length of the cable as shown at E and F in Fig. 2, which represents the top half of the cable. It is possible

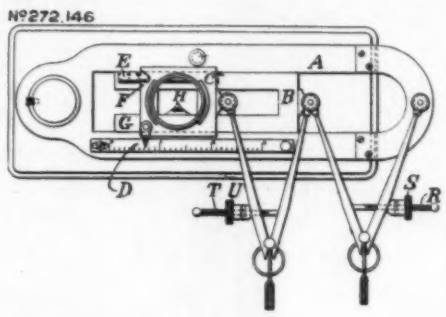


to use a smaller and cheaper cable if one of the phases—viz., the one connected to the outer conductor C—can be earthed as shown in Fig. 4, whereby the outer conductor is brought to the same potential as the lead sheath or earth. With this arrangement it may not be possible accurately to balance the capacities and inductances of all the phases, although it can be done for two of the phases as shown in Fig. 5. In this case the inductances and capacities between the A and C phases and between the B and C phases can be correctly balanced so that they shall be equal by effecting the cross connection between A and B at half the length of the cable as indicated at X. The capacity between the A and B phases will, however, differ, but the inequality can be reduced to a certain extent by increasing the diameter of the inner conductor A so as to increase the electrostatic capacity of that part of the cable, and this type of cable may be adopted where the amount of unbalancing is not excessive. The resistances of the several phase conductors A, B, and C can be balanced by using suitable metals and suitable sectional areas for each conductor, at the same time taking into consideration the geometrical position of the conductor in the manner described.—*June 16th*, 1927.

MEASURING AND TESTING INSTRUMENTS.

272,146. March 23rd, 1927.—MEASURING LINEAR DIMENSIONS, C. J. Chaplin, Drewston, Park-road, Camberley.

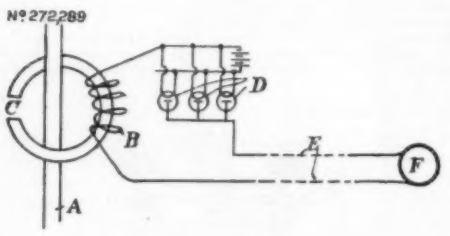
This invention relates to measuring instruments for measuring rectilinear distances. In connection, for example, with the determination of the summer growth of wood by measuring the distances between adjoining rings, it will be understood that if the distances or zones between adjacent rings represent a season's growth, the total summer growth would be represented by the integration of alternate zones, and, in practice, this integration is expressed as a percentage of the total width of wood made. The instrument comprises a bed-plate A with the central part cut away to leave a parallel-sided slot in which slides a slide B.



The slide B is also cut away centrally to form a parallel-sided slot in which is mounted a second slide C. The bed-plate carries a scale D, and the primary slide B carries a second scale E, against which pointers or indicators F, G carried by the secondary slide C can be read off repectively. The secondary slide C carries also a cursor H. A magnifying eye-piece is adapted to be fixed on the secondary slide C. The slide B can be moved relatively to the bed-plate A through the intermediary of a micrometer screw R and nut S, and the slide C can be moved relatively to the slide B through the intermediary of a micrometer screw T and nut U. The pointer G indicates the total movement, while F shows the intermediate distances.—*June 9th*, 1927.

272,289. March 9th, 1926.—IMPROVEMENTS IN AND RELATING TO CONTROL EQUIPMENT FOR ALTERNATING-CURRENT POWER SYSTEMS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Frederick Horton Clough, of Kilsby, Northamptonshire.

By means of the arrangement described in this specification the state of the load in various parts of an alternating-current power system is indicated at a central control station. A current transformer is associated with any selected part A of an alter-

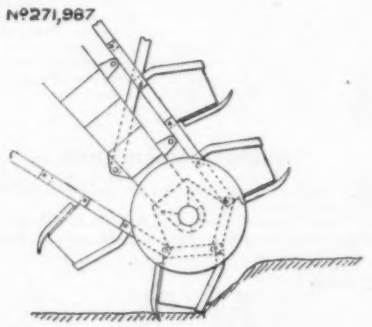


nating-current power system. The secondary winding B is open circuited and the transformer has an air gap C. The alternating-current is rectified by means of valves D and the rectified current is transmitted over pilot wires E to a direct-current instrument F at the control station. With this arrangement a very sensitive and at the same time very robust instrument can be used at the central station and small pilot wires may be employed. According to another scheme described in the specification a commutator is employed for rectifying the current.—*June 9th*, 1927.

MISCELLANEOUS.

271,987. April 6th, 1926.—DREDGER BUCKETS, W. T. Rennie, Les Gentianes, Chateau d'Oex, Switzerland.

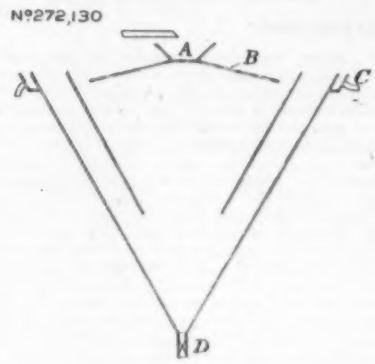
The inventor attaches prongs to the backs of the buckets of a



dredger in order to loosen the material being dredged. Incidentally, he says, the prongs tend to force the mouth of the bucket deeper into the ground.—*June 9th*, 1927.

272,130. February 3rd, 1927.—CLASSIFIERS, R. J. Marx, 133, Finsbury-pavement, London, E.C. 2.

The object of this invention is to separate from water finely divided solid matter, such as sugar beet or paper-pulp, which tends to accumulate air bubbles that reduce its specific gravity. The water is delivered into a dish A at such a rate that the overflow over the edge of the dish breaks up into drops. It is claimed that the impact of these drops on the disc B will burst the bubbles and that the solid matter will gravitate down to the



bottom of the hopper, while the clarified water overflows at C. The solids may be occasionally discharged at D.—*June 9th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

SATURDAY, JULY 16TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council Chamber, Guildhall, Cambridge. Eastern District meeting. 2 p.m.

WEDNESDAY, JULY 20TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Poole. Southern and South-Western Districts joint meeting. 11.30 a.m.

FRIDAY, JULY 22ND.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—The Court House, Jury-street, Warwick. West Midland district meeting. 2.30 p.m.

SATURDAY, JULY 23RD.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Council Chambers, Municipal Buildings, Whitley Bay. North-Eastern District meeting. 2.30 p.m.

CONTRACTS.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has obtained a six months' contract for the supply of Mazda lamps to the Weardale Steel, Coal and Coke Company, Ltd.

STANDARD TELEPHONES AND CABLES, Ltd., of Bush House, Aldwych, W.C. 2, has received from the Liverpool Corporation an order for the supply of 200 Gamewell fire alarm boxes for a new fire alarm and police telephone system, which it has been decided to install.

SIMON-CARVES, Ltd., of 20, Mount-street, Manchester, have received an order from the Vale of Neath Colliery Company, Ltd., for two Simon-Carves boilers, each rated to evaporate 25,000 lb. of water per hour, and fired by anthracite duff pulverised in Simon-Carves unit pulverisers. The contract includes economisers, superheaters, chimney, coal bunkers, coal-pulverising and handling plant and the necessary building to house them.

STOTHERT AND PITT, Ltd., of Bath, have received an order from Sir Robert McAlpine and Sons for Takoradi Harbour, West Africa, for six electric portal cranes with the "Stothert and Pitt" patented crank-operated horizontal luffing system, with a lifting capacity of 2 tons at 55ft. maximum radius, and for a petrol-electric caterpillar crane to lift 10 tons at 25ft. radius or 5 tons at 50ft. radius, also fitted with the firm's horizontal luffing system.

JOHN THOMPSON WATER-TUBE BOILERS, Ltd., of Wolverhampton and Imperial House, Kingsway, London, W.C. 2, has received an order from the Buenos Aires Great Southern Railway Company, Ltd., for two of its "John Thompson" vertical bent tube "Beta" type water-tube boilers, with steam and water fittings, for a daily working pressure of 120 lb. per square inch, together with superheaters, oil-burning equipment, feed pumps, steel chimney, pipe work, &c., for the oil fuel depôt, Dock Sud, Buenos Aires. The same firm has also received an order from the city of York Electric Lighting Department for two of its "John Thompson" patented vertical straight-tube "Alpha" type water-tube boilers, each having 10,800 square feet of heating surface, suitable for a daily working pressure of 200 lb. per square inch, with superheaters, forced draught chain grate stokers, economisers, a self-supporting steel chimney, induced draught and ash-removal plants, &c.

THE INSTITUTION OF ELECTRICAL ENGINEERS: STUDENTS' PREMIUMS.—The Council of the Institution of Electrical Engineers has made the following award of students' premiums for papers read before the Students' Sections during the session 1926–27:—Premiums to the value of £10 each to W. A. Cook, B.Sc., for his paper "High-voltage Insulation: Choice of Materials and Design;" to J. Eccles, B.Sc. Eng., for his paper "Notes on the Starting and General Performance of Rotary Converters;" to F. I. Ray, for his paper on "Automatic Telephony;" and to J. A. Sumner, for his paper "Electrical Supply for Rural and Agricultural Districts." Premiums of the value of £5 each to G. P. Barnard, for his paper "The Selenium Cell in Theory and Practice;" to S. B. Jackson, for his paper on "Propulsion of Ships by Electricity;" to S. N. Ray, M.Sc., for his paper "Electrons in Solid Conductors;" and to D. H. Wills, B.Eng., for his paper on "Oscillographs."